

INDIAN SCIENCE CONGRESS ASSOCIATION
PROCEEDINGS OF THE
FORTY-THIRD SESSION
AGRA-1956
PART III







INDIAN SCIENCE CONGRESS ASSOCIATION

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PROCEEDINGS OF THE FORTY-THIRD SESSION AGRA-1956

PART III ABSTRACTS



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PROCEEDINGS OF THE FORTY-THIRD INDIAN SCIENCE CONGRESS

PART III—ABSTRACTS

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43rd INDIAN SCIENCE CONGRESS, AGRA 1956

SECTION OF MATHEMATICS

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Abstracts

1. On the Theorems of Consistency for Absolute Riesz Summability.

B. N. PRASAD and T. PATI, Allahabad.

1. Let $\sum a_n$ be a given infinite series, and λ_n a positive, monotonic increasing function of n , steadily tending to infinity with n . Writing

$$A_\lambda(\omega) = A_\lambda^0(\omega) = \sum_{\lambda_n \leq \omega} a_n,$$

and
$$A_\lambda^r(\omega) = \sum_{\lambda_n \leq \omega} (\omega - \lambda_n)^r a_n, \quad r > 0,$$

the series $\sum a_n$ is said to be summable $[R, \lambda_n, r]$, $r \geq 0$, if $A_\lambda^r(\omega) / \omega^r \in BV(A, \infty)$, where A is a finite positive number.

2. The 'first theorem of consistency' for Riesz summability purports to the assertion that the effectiveness of a Riesz summability process increases along with the 'order', if the 'type' remains unaltered. The first general theorem concerning the relative effectiveness of any two Riesz methods of summability of which the types are different while the orders are identical is Hardy's well known extension (Proc. London Math. Soc. (2), 15 (1916), 72-88) of the classical 'second theorem of consistency'. Working on similar lines, Chandrasekharan (Jour. Indian Math. Soc., N.S., 6(1942), 168-180) gave an analogue of Hardy's theorem for absolute summability, confining one of the types to a special class of 'L-function' of the other. Recently Pati (Quarterly Jour. Math. (Oxford) (2), 5(1954), 161-168) extended the scope of applicability of the second theorem of consistency for absolutely summable series in the case in which the order is a positive integer, and still more recently Prasad and Pati have obtained a parallel result for the case in which the order is non-integral.

3. The object of the present paper is twofold. In the first place the authors generalise their previous results in the form of the following theorem and a parallel theorem for the case of non-integral order.

Theorem 1. If $\varphi(t)$ is a non-negative, monotonic increasing function of t for $t \geq 0$, steadily tending to infinity as t tends to infinity, such that, for positive integral k , $\varphi(t)$ is a $(k+1)$ th indefinite integral for $t \geq 0$, and

$$(*) \quad \begin{aligned} t \varphi^{(1)}(t) / \varphi(t) &\in BV(h, \infty), \\ t^r \varphi^{(r)}(t) / \varphi(t) &\in B(h, \infty) \quad (r = 2, \dots, k), \end{aligned}$$

where h is a finite positive number, then any infinite series which is summable $[R, \lambda_n, k]$ is also summable $[R, \varphi(\lambda_n), k]$.

Secondly, the authors obtain, in the form of the following result, an instance of what Prasad terms (Proceedings of the International Congress of Mathematicians, Amsterdam, 1954) a 'unified theorem of consistency'.

Theorem 2. The result of Theorem 1 remains true if the hypotheses(*) are replaced by

$$(**) \quad t^r \varphi^{(r)}(t) / \varphi(t) \in B(h, \infty) \quad (r = 1, 2, \dots, k)$$

and summability $|R, \varphi(\lambda_n), k|$ is replaced by summability $|R, \varphi(\lambda_n), k'|$ for every $k' > k$.

2. On the Absolute Nörlund Summability of a Fourier Series.

T. PATI, Allahabad.

1. Let Σa_n be a given infinite series with the sequence of partial sums $\{S_n\}$. Let $\{p_n\}$ be a sequence of constants, real or complex, and let $P_n = p_0 + p_1 + \dots + p_n$.

The sequence-to-sequence transformation

$$t_n = \sum_{v=0}^n \frac{p_{n-v} S_v}{P_n} \quad (P_n \neq 0)$$

defines the sequence $\{t_n\}$ of Nörlund means of the sequence $\{S_n\}$ generated by the sequence of coefficients $\{p_n\}$. The series Σa_n is said to be summable $|N, p_n|$ if $\{t_n\}$ is a sequence of bounded variation.

2. Let $f(t)$ be a periodic function with period 2π , and integrable in the Lebesgue sense over $(-\pi, \pi)$. We assume, without any loss of generality, that the Fourier series of $f(t)$ is

$$\Sigma(a_n \cos nt + b_n \sin nt).$$

We write

$$\varphi(t) = \frac{1}{2} \{f(x+t) + f(x-t)\}.$$

3. In the present paper the author establishes the following general theorem concerning the summability $|N, p_n|$ of a Fourier series at a point, which includes as a particular case, when

$$p_n = \binom{n+\alpha-1}{\alpha-1}, \quad \alpha > 0,$$

a previous result of Bosanquet on its summability $|C, \alpha|$, $\alpha > 0$ (Jour. London Math. Soc., 11(1936), 11-15).

Theorem. If $\varphi(t)$ is of bounded variation in $(0, \pi)$ and $\{p_n\}$ is a non-negative, monotonic non-increasing sequence such that (i) $P_n \rightarrow \infty$ as $n \rightarrow \infty$, (ii) $\{(n+1)p_n/P_n\}$ is a sequence of bounded variation and (iii) $\{\sum_{v=0}^n P_v / (v+1) / P_n\}$ is a sequence of bounded variation, then the Fourier series of $f(t)$, at $t = x$, is summable $|N, p_n|$.

3. On Local Property of $|C, 1|$ Summability of Fourier Series.

SRI NIVAS BHATT, Allahabad.

Let $f(t)$ be integrable (L) and periodic with period 2π , and let its Fourier series be denoted by

$$\frac{1}{2} a_0 + \sum_{n=1}^{\infty} (a_n \cos nt + b_n \sin nt) = \frac{1}{2} A_0 + \sum_{n=1}^{\infty} A_n(t).$$

Let $\varphi(u) = \{f(x+u) + f(x-u) - 2f(x)\}.$

It is well known that the absolute summability, $|C, \alpha|$, of a Fourier series for $\alpha > 1$ depends on the behaviour of the function in the immediate neighbourhood of the point under consideration, and thus it becomes a local property; but for the case $\alpha = 1$ Bosanquet and Kestelman (Proc. London Math. Soc. (2) 45 (1939), 88-97) have proved that the summability $|C, 1|$ no longer remains a local property. In fact one reason for this failure is that Lebesgue integral does not imply any thing more than $A_n(t) = O(1)$. In this paper author has shown that if $A_n(t) = o(\log n)^{-1-\varepsilon}$, $\varepsilon > 0$, the summability $|C, 1|$ of the Fourier series will become a local property. The following theorem has been proved :

Theorem. If

$$A_n(t) = o(\log n)^{-1-\varepsilon}, \varepsilon > 0.$$

and

$$\int_0^\eta \varphi(u) \left[1 - \frac{u^\delta \sin \frac{1}{2} u}{\eta^\delta \sin \frac{1}{2} \eta} \right] \frac{\sin(n + \frac{1}{2}u)}{\sin \frac{1}{2}u} du = O(\log n)^{-1-\varepsilon}$$

as $n \rightarrow \infty$, when $0 < \eta < \pi$, then the Fourier series of $f(t)$ is summable $[C, 1]$ at the point $t = x$.

4. On the Negative Summability of Fourier Series.

SHRI NIVAS BHATT, Allahabad.

We suppose that $f(t)$ is integrable L and is periodic 2π , and we denote the Fourier series of $f(t)$ by

$$\frac{1}{2}a_0 + \sum_{n=1}^{\infty} (a_n \cos nt + b_n \sin nt)$$

We write

$$\varphi(t) = \frac{1}{2}\{f(x+t) + f(x-t) - 2s\}.$$

The object of this paper is to extend Young's criterion for the convergence of Fourier series for negative order summability. The following theorem is proved :—

Theorem. If there is a $\Delta > 1$, such that

$$\int_0^t \varphi(u) du = o(t^{\Delta+1-\frac{1}{\Delta}}), \text{ as } t \rightarrow 0,$$

and

$$\int_0^t |d(u^{\Delta+\frac{1}{\Delta}-1} \varphi(u))| = O(t), \quad 0 < t < \pi,$$

the Fourier series of $f(x)$ is summable $(C, -\frac{1}{\Delta})$ to S at the point $t = x$.

5. A Convergence Criterion deduced from Riesz Summability of Fourier Series and its Conjugate Series.

[KUMARI] SULAXANA KUMARI, Allahabad.

Let $f(\theta)$ be integrable L in $(-\pi, \pi)$ and periodic outside this range with period 2π .
Let

$$f(\theta) \sim \frac{a_0}{2} + \sum_{n=1}^{\infty} (a_n \cos n\theta + b_n \sin n\theta) = \frac{A_0}{2} + \sum_{n=1}^{\infty} A_n(\theta). \quad (1)$$

Let

$$\phi_x(t) = \frac{1}{2} [f(x+t) + f(x-t) - 2s], \quad \phi_{\alpha}(t) = \frac{1}{t^{\alpha}} \int_0^t (t-u)^{\alpha-1} \phi(u) du, \quad \alpha > 0.$$

The following theorem has been proved :—

Theorem 1. If, for $\alpha > 0$,

$$(i) \quad \phi_x(t) = O\left(1/\log \frac{1}{t}\right),$$

as $t \rightarrow 0$, and

$$(ii) \quad \int_0^t |\phi(u)| du = O(t),$$

as $t \rightarrow 0$, then the Fourier series (1), at $\theta = x$, is summable $[R, \alpha]$ $\log \omega^{1+\frac{1}{\alpha}}$, $\log \omega$ for $\alpha > 0$, to sum S .

Also adding one more condition, namely

$$(iii) \quad A_n(x) > -K n^{-1} (\log n)^{1/\alpha},$$

K being a constant, in the above theorem, the convergence of the Fourier series (1) is obtained.

Analogous results for the summability and for the convergence of the conjugate series of the Fourier series (1) are also established.

6. On the Behaviour of the Fourier Coefficients.

[KUMARI] SULAXANA KUMARI, Allahabad.

Let $f(\theta)$ be integrable L in $(-\pi, \pi)$ and periodic outside this range with period 2π . Let

$$f(\theta) \sim \frac{a_0}{2} + \sum_{n=1}^{\infty} (a_n \cos n\theta + b_n \sin n\theta) = \frac{A_0}{2} + \sum_{n=1}^{\infty} A_n(\theta). \quad (1)$$

Then the series conjugate to the above Fourier series is

$$\sum_{n=1}^{\infty} (b_n \cos n\theta - a_n \sin n\theta) = \sum_{n=1}^{\infty} B_n(\theta). \quad (2)$$

Let

$$\Psi(t) = \frac{1}{2} \{ f(x+t) - f(x-t) \}, \quad \theta(t) = \Psi(t) - l,$$

$$(\ominus)_{\beta}(t) = \frac{1}{\Gamma(\beta)} \int_0^t (t-u)^{\beta-1} \theta(u) du, \quad \beta > 0.$$

Following theorem has been proved:—

Theorem 1. If, for $-1 < \alpha < 0$,

$$(i) \quad \int_0^t u^{-\alpha} \left| \frac{d}{du} \ominus_{\alpha+1}(u) \right| du = O\left(t/\log \frac{1}{t}\right)$$

as $t \rightarrow 0$, and if

$$(ii) \quad a_n = O(n^{\alpha-\delta}), \quad b_n = O(n^{\alpha-\delta}), \quad \delta > 0,$$

then the sequence $\{n B_n(x)\}$ is summable $(C, \alpha+1)$, to sum $\frac{2l}{\pi}$.

Putting $l = 0$, in condition (i) of the above theorem and taking an additional condition, namely the existence of

$$(iii) \quad \frac{1}{\pi} \int_{\rightarrow 0}^{\pi} \Psi(t) \cot \frac{t}{2} dt,$$

as a Cauchy integral at origin, the summability (C, α) of the conjugate series (2) is achieved.

Analogous results for the summability of the sequence $\{n A_n(x)\}$ and the Fourier series (1) are also obtained.

7. On the Absolute Convergence of a Series Associated with a Fourier Series.

R. MOHANTY and S. MAHAPATRA, Cuttack.

Let $f(t)$ be integrable in $(-\pi, \pi)$, periodic with period 2π and let its Fourier series at $t = x$ be

$$\frac{1}{2}a_0 + \sum (a_n \cos nx + b_n \sin nx) = A_0 + \sum_{n=1}^{\infty} A_n = \sum A_n.$$

We will be concerned in the present paper with the absolute convergence of the series $\sum \frac{S_n - S}{n}$, where S_n is the n^{th} partial sum of the Fourier series and S an appropriate number independent of n . More precisely a sufficient test has been given for the absolute convergence of the series and a converse theorem has been proved. A few remarks have been made regarding the interrelation of this series and the Fourier series, so far as their absolute convergence and absolute caesaro summability are concerned.

8. On the Summability of the Derived Fourier Series by Riesz's Logarithmic Means.

R. MOHANTY and M. NANDA, Cuttack.

Let $f(t)$ be integrable L in $(-\pi, \pi)$ and periodic with period 2π and let

$$f(t) \sim \frac{1}{2}a_0 + \sum_1^\infty (a_n \cos nt + b_n \sin nt) = \frac{1}{2}a_0 + \sum_1^\infty A_n(t). \tag{1.1}$$

Then the differentiated series of (1.1) at $t = x$ is

$$\sum_1^\infty n(b_n \cos nx - a_n \sin nx) = \sum_1^\infty nB_n(x). \tag{1.2}$$

We write

$$\phi(t) = \frac{1}{2}\{f(x+t) + f(x-t)\} - S, \quad S \equiv S(x),$$

$$\Psi(t) = \frac{1}{2}\{f(x+t) - f(x-t)\},$$

$$g(t) = \frac{\Psi(t)}{t} \doteq C, \quad C \equiv C(x),$$

$$\phi_\alpha(t) = \frac{1}{\Gamma(\alpha)} \int_t^\pi \left(\log \frac{u}{t}\right)^{\alpha-1} \frac{\phi(u)}{u} du, \quad (\alpha > 0),$$

$$\phi_0(t) = \phi(t).$$

$g_\alpha(t)$ ($\alpha \geq 0$) is similarly defined.

It is assumed that $g(t)$ is L in $(0, \pi)$ and is periodic with period 2π .

Definition. A series $\sum C_n$ is said to be summable by Riesz's logarithmic mean of order $K \geq 0$, or summable $(R, \log n, K)$ to the sum S , provided that

$$R_K(\omega) = \frac{1}{(\log \omega)^K} \sum_{n < \omega} \left(\log \frac{\omega}{n}\right)^K C_n$$

tends to a limit S as $\omega \rightarrow \infty$.

Then the following Theorem has been proved.

Theorem. If

$$\int_t^\infty \frac{|g_\beta(u)|}{u} du = o\left(\log \frac{1}{t}\right)^{1+\beta}, \quad \beta > 0$$

as $t \rightarrow 0$, then the series (1.2) is summable $(R, \log n, 1-\beta)$ to the value C .

9. On Strong Rieszian Summability of Dirichlet's Series.

(KUMARI) PRAMILA SRIVASTAVA, Allahabad.

Let Σa_n be a given infinite series and λ_n a positive monotonic increasing function of n , tending to infinity with n . Writing

$$A_\lambda(\omega) = A_\lambda^0(\omega) = \sum_{\lambda_n < \omega} a_n$$

and

$$A_\lambda^r(\omega) = \sum_{\lambda_n < \omega} (\omega - \lambda_n)^r a_n, \quad r > 0;$$

the series Σa_n is said to be summable (R, λ, r) to sum S , $r \geq 0$ if

$$\lim_{\omega \rightarrow \infty} A_\lambda^r(\omega)/\omega^r = S,$$

as $\omega \rightarrow \infty$. It is said to be summable $[R, \lambda, r]$, if also,

$$\int_0^X x \|d\{A_\lambda^r(x)/x^r\}\| = O(1),$$

as $X \rightarrow \infty$, where A is a finite number. And, if $A_\lambda^r(\omega)/\omega^r$ is of bounded variation in (A, ∞) the series Σa_n is said to be summable $|R, \lambda, x|$.

The theorem stated below is known: Let $S = \sigma + it$.

Theorem. *If the Dirichlet's series $\Sigma a_n e^{-\lambda_n s}$ is summable (R, λ, k) , $k \geq 0$ for $S = S^*$, then it is summable $|R, \lambda, k+1|$ for every S such that $\sigma > \sigma^*$.*

In the present paper the following generalisation of the above is obtained.

Theorem 1 *If $\Sigma a_n e^{-\lambda_n s}$ is summable $|R, \lambda, k|$, $k \geq 0$, for $S = S^*$, then it is summable $|R, \lambda, k|$ for every S such that $\sigma > \sigma^*$.*

Theorem 2, of this paper gives that the abscissae of summabilities $[R, \lambda, k]$ and $|R, \lambda, k|$ are the same. Theorems 3 and 4 give similar results for summability $|R, l, k|$. In the end is established

Theorem 5. *If $\Sigma a_n e^{-\lambda_n s}$ is summable $[R, \lambda, k]$, $k \geq 0$, for $S = S^*$, then it is summable $|R, l, k|$ for every S such that $\sigma > \sigma^*$.*

10. Exceptional Values of Meromorphic Functions, II.

S. M. SHAH, Aligarh.

In this paper we prove the following theorems.

Theorem 1. *Let $f(z)$ be a meromorphic function of finite order $\rho > 0$. Then*

$$(i) \quad \liminf_{r \rightarrow \infty} \frac{T(r)}{n_1(r, \alpha)} < \frac{4}{\rho \Sigma \delta(\alpha)}$$

for every α with three possible exceptions, provided $\Sigma \delta(\alpha) > 0$.

$$(ii) \quad \text{If } \Sigma \delta(\alpha) \geq 1, \quad \liminf_{r \rightarrow \infty} \frac{T(r)}{n_1(r, \alpha)} < \frac{3}{\rho[\Sigma \delta(\alpha) - 1]}$$

for every α with two possible exceptions.

(iii) If $\phi(z)$ be any meromorphic function (or a constant) satisfying the condition $T(r, \phi) = o(T(r, F))$, then

$$\liminf_{r \rightarrow \infty} \frac{T(r)}{n(r, F - \phi)} \leq \frac{3}{\rho}$$

for every ϕ , with two possible exceptions.

Theorem 2. Let $f(z)$ be a meromorphic function of finite order.

(i) If $\Sigma \delta(\alpha) > 0$,

$$\liminf_{r \rightarrow \infty} \frac{T(r)}{n_1(r, x) \log r} \leq \frac{4}{\Sigma \delta(\alpha)}$$

for every x , with three possible exceptions.

(ii) If $\Sigma \delta(\alpha) > 1$,

$$\liminf_{r \rightarrow \infty} \frac{T(r)}{n_1(r, x) \log r} \leq \frac{3}{\Sigma \delta(\alpha) - 1}$$

for every x , with two possible exceptions.

Here $n_1(r, x)$ etc have their usual meanings. (See abstract of my paper in Math. Student 23(1955) p. 70). I also prove more precise relations of the above type for entire functions.

11. On a Class of completely Monotone Functions.

S. K. BASU, Hooghly.

Let $\rho(x)$ be bounded and (i.e., non decreasing) in $(0, \infty)$ such that

$$f(t) = \int_0^{\infty} e^{-tx} d\rho(x) \quad (1)$$

and $f^{(n)}(t)$ exists and is continuous for all n and $t \geq 0$. The function $f(t)$ thus defined by the mass function $\rho(x)$, supposed normalized, is completely monotone.

It is known that the functions

$$f_k(t) = \left\{ f(t) - \sum_{\nu=0}^{k-1} f^{(\nu)}(0) \cdot t^\nu / \nu! \right\} / (-t)^k \quad (k = 1, 2, 3, \dots)$$

where $f(t)$ is defined by (1) are completely monotone in $(0, \infty)$ (P. Hortman and A. Winter, Amer. J. of Math. 76(1954), 199-206). The object of the present paper is to consider some properties of the class of functions $f_k(t)$.

12. Chain of Equal Circles.

SAHIB RAM MANDAN, Khargpur.

Here is a demonstration of the elegance of Grassmann's methods resulting into the following interesting picture.

The Orthocentres of the four triangles formed by a concyclic tetrad of points form another congruent and concyclic tetrad such that the vectors represented by the join of any two points of a tetrad are equal but opposite in sense to those represented by the joins of the corresponding points of the other tetrad. It is noted that if we start

with the second tetrad, we come back to the first one and hence the two tetrads and their corresponding allied elements are called conjugate to each other. The circumcentres of the two conjugate tetrads are collinear with their centroids; this line of collinearity is called the 'Euler line' of the tetrads.

Analogous results hold for two conjugate pentads, hexads etc and, in general, for two conjugate n -ads.

13. Trilinear Harmonic and Biharmonic Functions for Elastic and Fluid Flow Problems.

B. R. SETH, Khargpur.

Physical problems with rectilinear boundaries occur in Elasticity, Fluid Mechanics, Electricity and Magnetism and other allied subjects. They are solved either by a semi-inverse method or with the help of conformal transformation. The semi-inverse method assumes a solution of the field equations and then it is shown it satisfies the boundary conditions. For example, even to-day in all text books on Elasticity and Hydrodynamics the torsion problem (or liquid in a rotating cylinder) for an equilateral triangular section is solved by assuming the harmonic function $A(x^3 - 3xy^2)$ without deriving it from the boundary condition. For triangular and quadrilateral boundaries the use of trilinear coordinates directly gives a number of known and unknown results. If α, β, γ are the trilinear coordinates, the sides of the triangular section are $\alpha = 0, \beta = 0, \gamma = 0$. For quadrilateral sections the sides can be taken as

$$\alpha = 0, \beta = 0, \gamma = 0, l\alpha + m\beta + n\gamma = 0.$$

For the torsion problem we find that the stress function for an equilateral section is of the simple form $A\beta\gamma$, A being a constant. In like manner we get a number of results for quadrilateral sections. For transverse vibrations of an equilateral membrane of height h the transverse displacement w is found to be of the symmetrical form

$$w = A \left[\sin(m\beta - n\gamma) + \sin(m\gamma - n\beta) + \sin(m\gamma - n\alpha) + \sin(m\alpha - n\gamma) \right. \\ \left. + (m\alpha - n\beta) + \sin(m\beta - n\alpha) \right] \quad (1)$$

$$m = 2\pi\gamma/h, \quad n = 2\pi\alpha/h,$$

A being constant and r, s , any integers.

This result holds good for the transverse vibrations of simply supported plates as well. Similar results are obtained for a number of other triangular membranes.

14. Stress Concentration of an Isotropic infinite thin Plate with a Parabolic boundary under prescribed displacement on the boundary.

D. N. MITRA, Khargpur.

Stress functions have been expressed in terms of two analytic functions $\Omega(z), \omega(z)$. The equation giving the displacement in terms of these analytic functions has been transformed into an integral equation, the boundary of the plate being mapped conformally on a unit circle. The said analytic functions are obtained by solving the above integral function and its conjugate.

15. The Method of Wiener-Hopf in Elastic Problems.

GUNADHAR PARIA, Khargpur.

A procedure has been given to show how the method of Wiener-Hopf for the solution of non-homogeneous integral equation can be applied to determine the stresses

in a thin elastic plate of infinite length but of finite breadth, due to non-homogenous loading conditions on the boundary. The results are expressed in integral forms.

16. Further Problems of Elastic Plates containing Circular Holes.

A. M. SEN GUPTA, Ranchi.

In this paper, the influence of Stresses around a Circular Hole in a semi-infinite Plate subjected to two equal and opposite couples M , applied to its straight edge at two points at a very small distance " b " apart, the axes of the Couples being normal to the Plate, is discussed.

17. On the Stresses in a Composite Truncated Cone due to Shearing Stresses on the Curved Surface

SISIR CHANDRA DAS, Chandernagore.

Solutions have been obtained for the problem of a truncated cone reinforced by another cone with the same axis but of a different material when the outer curved surface is under uniform shearing stresses. The particular type of applied stress discussed in the paper develops due to frictional forces that cause the twisting of the solid about its axis.

The problem under investigation is a more general one than that of a circular composite cylinder which has also been solved by the author recently. (Proc. of the 1st Congress on Theoretical and Applied Mechanics, I.I.T., Kharagpur)

18. Note on the Stresses in Twisted Composite Spheres.

SISIR CHANDRA DAS, Chandernagore

In this paper solutions have been obtained in the case of composite concentrated spheres when it is twisted by terminal couples.

19. Stresses in a Rotating Disc bounded by two Confocal Parabolas.

B. B. CHATTERJEE, Jadavpore

An attempt has been made here to find stresses in a rotating disc bounded by two confocal parabolas. The method of solution given by Stevenson(1943) has been made use of. The peripheral stress has been worked out at points of interest.

20. Finite extension of an Aelotropic Hollow Cylinder.

J. RAMAKANTH, Hyderabad-Deccan.

The problem of extension of a cylindrical beam of any cross-section subjected to uniform tension was solved by Seth. B. R. (1945) when the material had hexagonal type of aelotropy using finite components of displacement.

The corresponding problem for a hollow cylinder has not yet been solved. In this paper the problem of finite extension of a right circular hollow-cylinder of rhombohedral material is solved. Analytic solution in converging power series is obtained for the governing differential equation. Numerical values of the constants involved in the expressions for stresses and strain are obtained in case of Beryl.

21. Propagation of a General Type of Disturbance along a Uniform Transmission Line.

BIBHUTIBHUSAN SEN, Jadavpur.

In this paper the method of Laplace transformation has been used to deduce the condition for the existence of 'distortionless' waves in a uniform transmission line when general types of disturbance other than those having purely sine or cosine forms are propagated along it.

22. On the Application of Schwarz Formula in Hydrodynamical Problems.

KAMINI KUMAR DE, Calcutta.

Schwarz -Formula has been applied to find the stream function for motion of non-viscous fluid in the presence of a cylinder whose cross section is of a general character in the case of shear motion. For this purpose region outside the cylinder is mapped into region inside a circle of unit radius. Then with the help of an Extension of Blasius Theorem by the author (Bull. Cal. Math. Soc. Vol. 45 (1953) pp. 121-124) the force exerted on the cylinder has been calculated. From this general case force exerted on cylinder of elliptic cross section, an equilateral triangle with rounded corners, a square with rounded corners have been deduced as particular cases. The moment also has been calculated and in that connection we come across a case of considerable interest.

23. Slow Viscous Drag.

Y. D. WADHWA, Khargpur.

Seth has shown that slow viscous motions of a liquid can be obtained by superposing on the corresponding perfect motion a motion due to concentrated force. This force has been shown to be the drag suffered by the solid. The method, however, needs a slight modification to include cases in which the velocity potential V of the perfect motion is not of the form $xf(\xi)$, where $\xi = \text{constant}$ represents the solid boundary in orthogonal curvilinear coordinates. This modified form of the principle is applied here to find the drag on an infinite cylinder moving slowly through a viscous liquid when the cross section of the cylinder is

- i) a lemniscate of Bernoulli
- ii) a cardioid
- iii) an epi-cycloid.

24. The Stability of a Spherical Bubble in Non-Newtonian Liquid.

M. K. JAIN, Khargpur.

This stability of a spherical bubble in non-Newtonian liquid is discussed by introducing the second order terms in the stress-strain velocity relations of classical hydrodynamics. We show that the deformation will be stable or unstable according as the bubble is collapsing or growing and further more we show that these results also hold good for viscous liquids.

25. On a Static Solution of Field Equations in Einstein's Unified Field Theory.

N. N. GHOSH, Calcutta.

The paper is concerned with a static solution of field equations in Einstein's unified field theory. Using general indices k, m, n, l instead of 1, 2, 3, 4, the symmetric components S and the anti-symmetric components a of the nonsymmetric tensor field $g_{\mu\nu}$

considered in this article are represented by $S_{kk}, S_{mm}, S_{nn}, S_{ll}, a_{kl}, a_{lk}, a_{mn}, a_{nm}$ where S_{kk}, S_{ll}, a_{kl} are functions of x_k only and S_{mm}, S_{nn}, a_{mn} are each expressible as products of a function of x_k and x_m . On solving the relevant field equations there appears a parameter k in the process which can take positive, negative or zero values yielding three types of solution. It is found that the usual spherically symmetric solutions, considered by Bonnor, result when k is negative. The other two types (which are not spherically symmetric) are also considered and general solutions have been obtained.

26. On Some Isotropic Solutions for the case of Fluid Sphere in Relativity.

R. V. WAGH, Poona.

For a line-element of the form, viz.

$$ds^2 = H(r, t)dt^2 - F(r, t)(dr^2 + r^2d\theta^2 + r^2\sin^2\theta d\phi^2), \quad \dots (1)$$

one important solution amongst others is found using the condition of isotropy in the form,

$$\frac{d^2y}{d\sigma^2} + \psi(\sigma)y^2 = 0 \quad \dots (ii)$$

where, $y = F^{-\frac{1}{2}}$. It is given by

$$y = (m \pm \sigma)^{-2} \quad \dots (iii)$$

when $\psi(\sigma) = -6$. This solution applied to the case of fluid sphere whose radius at the epoch $t = T$ is given by an equation of sixth degree yielding

$$(M + R^2)^2 = 2A \quad \dots (iv)$$

Here $M = (m)_{t=T}$ and $A = (a)_{t=T}$; the total energy of the fluid sphere is also found to be given by

$$(E)_{t=T} = \frac{\pi A \dot{M}}{30} (8M - 3\sqrt{2A})(\sqrt{2A} - M)^{\frac{2}{3}} \quad \dots (v)$$

27. Homologously Contracting Stars passing through Equilibrium Configurations.

G. BANDYOPADHYAY, Khargpur.

Complete investigation of different cases under which a gas sphere with power law of opacity and generation can undergo slow homologous contraction was undertaken in a previous paper (Proc. Nat. Inst. Sc. Ind. Vol. 14, 1948, pp. 29-43). This investigation is a continuation of an investigation (Thomas 1930) and surmounts the mathematical difficulty which appeared in the work. Investigation of cases where the laws are other than power law has also yielded some result (Abstracts, Indian Science Congress Mathematics Section 41st. Session, 1954, abstract No. 13).

An important question which arises in connection with such investigation is 'what further conditions are needed in order that the dynamical configurations at different epoch are the same as the statical configurations with changes in the values of the parameter'. This investigation was done along with the previous investigation where only power law was considered. The analogous discussion under wider law has been undertaken in this paper.

SECTION OF STATISTICS

President : PROF. K. NAGABHUSHANAM, M.A., Fil. Lic., D.Phil.

Abstracts

DISTRIBUTION THEORY

1. A Bivariate Beta Distribution

A. M. GUN, Calcutta.

Let x_1 and x_2 be distributed in the bivariate normal form with mean vector $(0, 0)$ and covariance matrix $\begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix}$

Suppose further that $(x_{i\alpha}) : (2 \times n)$ are n independent, random observations on the two variables. Then $\sum_{\alpha=1}^n x_{1\alpha}^2/2$, $\sum_{\alpha=1}^n x_{2\alpha}^2/2$ are each a gamma variable with parameter $n/2$. This fact and its multivariate counterpart were utilized by Kibble (1941) and Krishnamoorthy & Parthasarathy (1951) to get bivariate and multivariate analogues of the gamma distribution. Since the ratio $z_1/(z_1 + z_2)$, where z_1 and z_2 are independent gamma variables with parameters, a_1 and a_2 respectively, is a beta variable with parameters (a_1, a_2) , we can, taking Kibble's method only a step further, obtain a bivariate beta distribution. This has been done in this paper, avoiding, however, the method of characteristic functions.

Incidentally, for the gamma distribution the following reproductive property has been shown to be true :

If (y_1, y_2) and (y'_1, y'_2) be distributed in the bivariate gamma form with parameters (a, ρ) and (b, ρ) respectively, then $(y_1 + y'_1, y_2 + y'_2)$ are also so distributed with parameters $(a + b, \rho)$.

2. Distribution of the ratio of logarithm of any one of the ranges of samples from rectangular population to the sum of the logarithm of each of them

D. N. LAL and D. MISHRA, Patna.

In this paper the distribution referred to in the title has been obtained and also the probability that the largest of these ratios will exceed a preassigned value. It is suggested that this can be used for testing the homogeneity of the samples.

3. On Ranking Parameters of Scale in Type-III Populations

K. C. SEAL, Calcutta.

A decision procedure having easy practical application is formulated for selecting from a given number of Pearsonian Type-III Populations a group containing the

population with the smallest parameter of scale. It is shown that the suggested procedure has many desirable properties and is applicable to a wide variety of problems.

ESTIMATION & TESTING OF HYPOTHESIS

4. On testing simple hypothesis

B. R. BHAT, Dharwar.

With the usual notation, inside a best critical region to test θ_0 against θ_1 , we have $P(E|\theta_1) \geq K P(E|\theta_0)$. If this corresponds to an inequality $F \geq F_0$, where F and F_0 do not depend on θ_1 , then we have a U.M.P. test. Under the usual conditions of continuity and derivability of $P(E|\theta)$, U.M.P. test does not exist, and it has been proved that a one-sided U.M.P. test always exists, the test criteria being given by the distribution of $F = \frac{d}{d\theta} \left(\frac{P(E|\theta)}{P(E|\theta_0)} \right)_{\theta=\theta'}$ ($\theta_0 < \theta' < \theta_1$). If $P(E|\theta)$ is a one-valued function of θ , then F is also a one-valued function of θ , and the boundary of the b.c.r. is given by $F = F_0$, which amounts to $\theta = \theta_0$. Further, it is possible to prove that one-sided U.M.P. test does not exist for a simple hypothesis involving more than one parameter.

5. Method of Matching used for the Estimation of Test Reliability

P. K. BOSE and S. B. CHAUDHURI, Calcutta.

In this paper a new method has been suggested to estimate the reliability coefficient of a test. According to this method a test is first split up into a number of parallel sub-tests on the basis of the difficulty values of the test items. Cochran's Q-test and Wilks' Lmve test have been applied for the purpose. Some theorems have been established as to the mean and variance of a sub-test and covariance between any two sub-tests in terms of the difficulty values of the test items and necessary conclusions have been made on the basis of these results. Spearman-Brown's formula for multiple test length is applied after calculating the reliability of a single sub-test. The conditions imposed for the successful application of this method are very mild and are very often satisfied in the actual field of work. This has been compared with the other well-known methods and it has been shown that this is decidedly better than the other ones. Comparison between split-half and split-multiple tests have also been discussed. An illustration has been given comparing the reliability coefficients estimated by various methods.

6. On some aspects of testing multiple hypotheses

K. C. CHANDA, Bombay.

Attempt has been made in this paper to consider tests of multiple hypotheses about an unknown parameter θ in a certain otherwise known probability function, of the type $\psi(\theta) = 0$ where $\psi(\theta)$ is an arbitrary function of θ and where we assume that the equation $\psi(\theta) = 0$ has a finite number k of distinct roots $\theta_1, \dots, \theta_k$. Two tests have been constructed which are respectively equivalent to the most powerful and uniformly most powerful unbiased tests of Neyman Pearson. Further details have been discussed for the special case when the distribution is of the exponential type.

7. A Note on the Estimation of True Scores

S. D. DUBEY, Khargpur.

The problem of estimating the true score of an individual when several examiners' marks are available has been studied by Hartog, Rhodes and Burt in their work, 'The Marks of Examiners' (1936). Earlier F. Y. Edgeworth (1888, 1890) also studied such a problem but he does not appear to have given any expression for the estimation of true score. Some of his ideas were illustrated by Rhodes (1936) who did not follow Edgeworth's approach but proceeded to obtain a new estimating formula. The method proposed by Rhodes does not appear to be satisfactory, especially as it involves, apart from lengthy approach, unwieldy expression for the error variance. The computation required is also considerable when number of examiners is large. The method suggested by Burt in the same work seems to be in no way simpler.

In this note is proposed a new method of estimating true scores of individuals in such situation. The formula leads to a simple expression for the error variance requiring considerably less amount of computation. The estimated true scores of candidates by the present approach appear to possess minimum variance compared to those of different methods of estimation.

8. Economic centering of machines in cases of non-normal variation

A. K. GAYEN, Khargpur.

In this paper economic centering of machine has been studied on the assumption of non-Normal variation of the quality characteristic of the manufactured articles. It is interesting to find that for a slightly asymmetrical population economic centering is possible at two different positions, that for moderate departures both in the skewness and kurtosis of the parent distribution there are more than two different adjustments. Centering at a unique value is possible only when perfect normality of article measures is assured. The deviations of the calculated points from the mid-tolerance value are found to be large for slight irregularity of the distribution even when the cost of re-work equals that of scraping. The estimating equations have been derived and an example has been worked out.

9. Use of technical heights of jute-plants for the study of manurial effects on fibre yields

N. C. GIRI, Barrackpore.

Application of manures increases the fibre yield and the technical height of jute crop. High positive correlation exists between yield and technical height. Due to the difficulties for the extraction of fibres, an attempt is made to investigate the possibility of using technical heights for the study of manurial effects on fibre yield. The distribution of technical heights is found to be non-normal skew. Proper correction for using analysis of variance technique in testing the effect of manure on technical height is made. As it appears to be a laborious job, non-parametric tests for K samples and 2 samples are performed on this skew population. The test confirms that the manurial responses on yield and technical height are of similar nature. Fibre yields of jute plants can be estimated from the technical heights by a curvilinear regression.

10. Further contribution to the theory of a non-parametric test

A. R. KAMAT, Poona.

In a previous paper a non-parametric test was proposed to test the hypothesis that the two given samples come from populations with equal means and equal dispersions. The test was based on ranking the observations of the two samples taken together and the test statistics proposed was $D_{n,m} = R_n - R_m + m$ where R_n, R_m are the ranges of the ranks assigned to the two samples which are of sample sizes m and n respectively. In this paper moments of $D_{n,m}$ are found and the limiting distribution of $D_{n,m}$ is studied for large m, n with the help of these moments. The limiting distribution of $D_{n,m}$ is not normal. The symmetrical case $m = n$ is studied in more detail.

If the means of the populations are equal, $D_{n,m}$ will pick out differences in dispersions provided the shapes are similar. If the shapes are not similar, it may pick out differences in dispersions as well as shapes. A small difference in population means does not affect the test very much but otherwise the difference in means will render the test ineffective. Empirical comparison with the F -test shows that although for normal samples the F -test is superior, for samples which are not normal the D -test compares well with F -test. It seems that it is better than the test proposed by Rosenbaum in 1953.

11. Approximation by a power of χ^2

A. R. KAMAT and Y. S. SATHE, Poona.

When there is a slow-moving trend in the mean, various estimators based on the first or second variate differences have been suggested and studied by Von Neumann and also by one of us. While these estimators are useful when the variability is to be estimated, they cannot be used for testing two estimates of variability since no exact distribution of any of these estimators has been found. Recently Cadwell (1953) has used a power of chi-square to approximate the distribution of the range and the mean deviation. We are using the same idea to approximate the distribution of estimates based on the first or second differences. In this paper we try to fit a power of chi-square to one of these estimators viz., $\delta^2 = \frac{1}{n-1} \sum (x_i - x_{i+1})^2$ and we find that the fit is quite good and better than the type VI Pearson curve suggested by Von Neumann. It is found that the same power of chi-square can be used over a wide range of sample sizes and hence test procedures corresponding to F -Tests, to test the consistency of two estimates of variability based on δ^2 , can now be adopted.

12. On the estimation of the Spectrum

V. K. MURTHY, Waltair.

In this paper stationary processes whose spectra include saltus part also are considered. Under suitable conditions consistent estimation of the spectral intensity is studied at points where it is meaningful to do so.

13. Study on the estimation of Fibre yield

S. N. SEN and N. C. GIRI, Barrackpore.

In the estimation of fibre yield, both experimental and non-experimental errors, involved in the successive measurements at the post-harvest operational stages, create difficulty in getting the true effect of treatments. The fibre yield can easily be estimated from green weight by both ratio and regression methods. The ratio estimate is found to be no less efficient than the regression estimate since the relationship $\rho = R \frac{\hat{S}_x}{\hat{S}_y}$ holds good. The ratio $R = \Sigma y / \Sigma x$ is also a consistent estimate. Non-

parametric test over the ratio (\hat{R}) shows that due to changes in the manurial treatments there will be no change in R . The test for the equality of the regression coefficients of fibre yield on green weight as calculated from different samples treated with different manures also indicates this constant behaviour of these estimates. The fibre yield can efficiently be estimated from the green weight by the ratio method.

DESIGN & ANALYSIS OF EXPTS.

14. Comparison of the Means of k Normal Populations with the Mean of a Control

P. K. BHATTACHARYYA, Calcutta.

There are $(k+1)$ normal populations $\pi_j : N(\mu + \delta_j, \sigma^2)$, $j = 0, 1, \dots, k$; $\delta_0 = 0$ (μ and σ^2 are known and δ_j are unknown). A population π_j ($j \neq 0$) is said to belong to the group G_1 with respect to π_0 if $\delta_j \geq \delta$ (a given positive quantity), to the group G_2 if $|\delta_j| < \delta$ and to the group G_3 if $\delta_j \leq -\delta$. The problem is to allocate each of the k populations π_1, \dots, π_k to one of these groups. Samples of equal size are taken from π_1, \dots, π_k and a class of decision rules $D_1(\lambda)$ defined as follows is considered.

Include π_j in G_1 if $x_j - \mu \geq \lambda$
 G_2 if $|x_j - \mu| < \lambda$
 G_3 if $\bar{x}_j - \mu \leq -\lambda,$

where x_j is the sample mean from π_j . λ is then so chosen that the minimum probability of correct decision with $D_1(\lambda)$ is greater than that with any other $D_1(\lambda')$. For unknown μ a design is considered in which the total number of blocks are divided into k sets, each containing the same number of blocks. In each block of the j th set one observation is taken from each of π_0 and π_j , $j = 1, \dots, k$. A decision rule $D_2(\lambda)$ similar to $D_1(\lambda)$ is based on the best linear estimates of the δ_j 's from these observations and the optimum value of λ is determined with the same guiding principle as above.

15. Simplified Analysis of Singly Linked Blocks

K. R. NAIR, Dehra Dun.

The dual of a balanced incomplete block design having the parameters v, k, r, b , λ can, in the language of Youden (1951), be called " λ -linked blocks" since every pair

of blocks of the dual design will have λ treatments in common. When $\lambda = 1$, the dual is called *Singly Linked Blocks*. S. S. Shrikhande (1952) and P. M. Roy (1954) independently showed that singly linked blocks are p.b.i.b. designs with two associate classes. R. C. Bose and Shimamoto (1952) had simplified the steps in the analysis of the general class of two-associate p.b.i.b. designs. But this simplification does not naturally go far enough when special types of two-associate p.b.i.b. designs such as the simple square lattice, singly linked blocks etc are separately considered. The purpose of this paper is to give a specially simplified method of analysis for singly linked blocks. The method is illustrated on real experimental data.

16. $p \times (p-1)$, $(p-2)$ -ple Rectangular Lattices

P. M. Roy, Calcutta.

A simple general method for the analysis of $p \times (p-1)$ rectangular lattices has been dealt with in this paper. Simple procedure for the estimation of the variances of the varietal differences has also been indicated. In particular $p \times (p-1)$, $(p-2)$ -ple rectangular lattice (when a complete set of $p \times p$ orthogonal latin squares exist) has been analysed. Expressions for estimating the variances of all the six types of varietal differences in which all of them fall have been worked out. A suitable association scheme for the identification of the type of a varietal difference has also been given.

TIME SERIES

17. On a new method of trend-elimination

B. R. BHAT, Dharwar.

The effect of the classical method of moving averages or moving arithmetic means on trend, seasonal and random components, under additive and multiplicative models has been compared with the method of moving geometric means; and the latter seems to be better as a representative of the trend than the former, when it is exponential or, in general, steep. This can be illustrated with the help of a few artificial examples.

18. Cyclic trends in the thermal character of the atmosphere

P. JAGANNATHAN, Poona.

The march of temperature of the atmosphere is to a large extent a systematic oscillation repeating practically in a similar manner year after year. For representing this stationary oscillatory process, a suitable mathematical model is:

$$T_t = \bar{T} + \sum_r a_r \sin \left(\frac{2\pi r t}{P} + \varphi_r \right)$$

T_t representing the atmospheric temperature at any time 't' of the year, \bar{T} , the mean annual temperature, P the period (here the year), $a_1, \varphi_1, a_2, \varphi_2$ etc., are the amplitudes and phase angles in respect of the annual, half-yearly etc. waves.

The annual and the half-yearly oscillations in the mean temperature of air at 4 feet above ground level at 167 meteorological stations in India and neighbourhood have been separated. The dependence of the components of the vectors of the different

oscillations on the location of the stations have been determined. Regression equations for representing the components of the oscillations as a linear function of latitude, longitude and elevation have been derived. The fit of these representations has been found to be fairly good, the correlation between the actual and the calculated values being of the order of 0.8 to 0.9 generally. The significance of the gradients with respect to the positional co-ordinates has been discussed.

19. Study of Topographic Models by the Autoregressive Schemes

S. N. SEN, Barrackpore.

The correlogram approach is found to be helpful in determining the trend of soil fertility in any topography. Whether the trend in soil fertility is more pronounced in horizontal or vertical direction may be observed by calculating autocorrelations of different lags in both the directions. Small sample and large sample tests are performed for testing randomness of the field.

To study the behaviour of the trend in the soil fertility, different autoregressive stationary models are assumed for the one dimensional field. The auto-correlation coefficients found out from the stochastic models deviate from the empirical values especially for distant lags. The structure of the correlogram depends more upon the empirical auto-correlation coefficients than upon the underlying stochastic models. These deviations depend upon the assumptions regarding the errors of observations.

The empirical relationship between lag (L) and the corresponding auto-correlation coefficients (r_L) is verified as : $r_L = \mu e^{-|\lambda|L}$ where μ & λ are suitable constants. For certain topography, the relationship $r_L = a + b \log (L+c)$ is also found to hold. Further work with different models is in progress.

SAMPLE S RVEYS AND APPLICATIONS

20. Effect of state irrigation on total irrigation in Uttar Pradesh

A. P. BHATTACHARYA, Roorkee.

Irrigation from various sources, such as lakes, open wells, reservoirs, canals, embankments, etc. has been extensively practised in Uttar Pradesh from times immemorial. But it is only since about a century that state-owned and state-managed canals and storage reservoirs came into existence, and the area irrigated from these state-managed sources has been designated as state irrigation. An attempt has been made in this paper to investigate how far state irrigation was effective in materially augmenting total irrigation (which means the total area under all forms of irrigation, including state irrigation).

It was found that the effect of the introduction of state irrigation in Uttar Pradesh was a significant increase in the total irrigation, particularly in western and southern U.P., where state irrigation is mainly concentrated. It has a tremendous effect in supplementing and not supplanting irrigation from other sources.

21. On the method of overlapping maps in sample surveys

DES RAJ, Calcutta.

In multipurpose surveys involving the estimation of several characters, it is usually found desirable to select the units with one set of probabilities for estimating one group of characters and with a different set of probabilities for estimating another group of characters. An important problem arising in such a situation is that of designing a suitable selection procedure so that the sample units for the two types of enquiry are identical or near to each other. It is shown that this is a problem in linear programming. Lahiri's serpentine method, which is the same as Dantzig's basic solution, is proved to be optimum in a certain sense. Keyfitz' problem (of selecting units with different probabilities at two successive occasions to maximise the probability of identical units) and the problem of Goodman & Kish (viz. selecting a pair of units, one from each stratum, such that the probability of selecting a certain type of pair is maximised) are solved as particular cases of the general problem.

22. The concept of a Super-population in Sampling from Finite Populations

M. V. JAMBUNATHAN, Mysore.

The calculation of the variance of the estimate obtained from a random sample drawn from a finite population involves tedious algebraic work, and several writers have suggested the concept of an infinite super-population of which the given finite population is to be regarded as a random sample. By this device, the required sampling variance is related to the infinite population as a result of which the computations become comparatively simple. The object of this paper is to make a systematic study of the application of this method to various sampling plans such as simple random sampling, stratified sampling, bivariate sampling, stratification after sampling, etc.

SECTION OF PHYSICS

President DR. B. PETERS, Ph.D.

Abstracts

1. NUCLEAR PHYSICS AND COSMIC RADIATION

1. An Absolute Method for the Determination of Absorption Cross-section of Thermal Neutrons

N. K. GANGULY and A. M. GHOSE, Calcutta.

In view of the reported conflicting values for the thermal neutron cross section for boron, which is used as a standard for all slow neutron absorption experiments, it is desirable to develop an absolute method for thermal neutron cross-section determination. The present method has been developed to meet this requirement. The method is based on the principle that in a 'poor' geometry experiment in which source is surrounded by a spherical shell of absorber, the number of neutrons actuating the detector is independent of the scattering by the absorber. In applying this principle to practice correction must be made for angular emergence of the neutrons from the moderator, which is used to slow down neutrons. The following expression has been finally derived for the transmission of neutron through an absorber

$$\psi = \int_0^1 x \phi(x) e^{-S(x)f(\sigma)} dx \bigg/ \int_0^1 x \phi(x) dx$$

where $f = \frac{\sigma N \rho}{M}$; σ = thermal neutron absorption cross-section; N = Avogadro's Number; ρ = density and M = molecular weight of the specimen; $S(x)$ = path length through absorber at an angle $\cos^{-1} x$;

$$\phi(x) = \frac{1}{2(1+x)^{\frac{1}{2}}} \exp. \left[\frac{1}{\pi} \int_0^{\pi/2} \frac{y \tan^{-1}(x \tan y)}{1-y \tan y} dy \right]$$

The method was employed to determine thermal neutron capture of NaCl, using indium foil as neutron detector. The beta activity induced in indium was counted by a scintillation counter. To isolate the effect of thermal neutrons from epi-thermal ones, the usual cadmium difference technique was employed. The final value obtained is 29.0 ± 1.5 barns, which agrees with previous determinations by oscillation danger coefficient method. The principal source of error in the present experiment is due to interference by epi-thermal neutrons. Experiments are now in progress to eliminate this interference and thereby improve the accuracy of this method.

2. Characteristics of Reactors producing uniform Power throughout the active Volume

S. B. D. IYENGAR and G. S. MANI, Bombay.

The basic equation on one group approximation for an idealised reactor (a homogeneous reactor with pure U^{235} as fuel) with non-uniform fuel distribution is obtained, and is seen to be of the Schrödinger type. The uniform power condition yields for the shape of the "potential" in the Schrödinger equation, the inverse of the ground state wave function. The criticality conditions for such reactors are obtained from normalisation of the "potential" at the origin. Expressions for fuel distribution and criticality condition for spherical and cylindrical reactors with reflectors are given. The case of more practical type of reactors is discussed.

3. Angular Distribution of Pions in High Energy Nuclear Events

INDERJIT SINGH and F. C. AULUCK, Delhi.

The limitations of perturbation approach for handling Yukawa processes are well-known. Recently, Fermi has explained the multiple production of mesons in an extreme relativistic nucleon-nucleon collision from considerations of statistical equilibrium. The energy of the colliding nucleons is assumed to concentrate for a while, in a volume of radius equal to the pion Compton wave-length, which as a consequence, attains a very high temperature. A number of reactions are triggered off, and equilibrium is attained by the production of a pion shower, having the appearance of a narrow double-cone in the centre-of-mass system. Fermi's distribution is in excellent agreement with the experimental results.

In Fermi theory the volume of the 'hot spot' is assumed to be independent of the impact parameter of the collision. This is too drastic a simplifying assumption. A more logical situation is to consider, following Bhabha, the 'hot spot' as consisting of two over-lapping pion-clouds. Thus in our case, the volume which is suddenly loaded with energy, becomes a function of the impact parameter of the collision. Making a detailed thermodynamical analysis of this region in phase-space, we get for the angular distribution of pions in the centre-of-mass system, produced in a high energy nuclear collision of impact parameter P ,

$$\frac{dN}{d\eta} = \frac{\alpha M c^2 R^3}{\pi W \hbar^3 \gamma^3} \left[\frac{2}{\rho^2 \eta^2 (1 - \rho^2 \eta^2)} - \frac{1}{\rho^3 \eta^3} \ln \frac{1 + \rho \eta}{1 - \rho \eta} - \frac{2}{\pi} \left\{ f - \eta^2 \frac{df}{d(\eta^2)} - \rho^2 \frac{df}{d(\rho^2)} \right\} \right],$$

where

$$f = f_1 - f_2$$

$$f_1 = \frac{\pi}{\sqrt{q(1-q)}} \cdot \frac{B \sqrt{(1-B^2)}}{2\rho} \cdot \frac{d}{d\rho} \left\{ \frac{(\rho^2-1)}{2\rho} \ln \frac{p\sqrt{q} + \{1 - \sqrt{1-q}\} \{1 - \sqrt{1-p^2}\}}{p\sqrt{q} - \{1 - \sqrt{1-q}\} \{1 - \sqrt{1-p^2}\}} \right\} \left[B > 0 \right],$$

$$f_2 = \frac{\pi}{4} \frac{B(1-B^2)}{(1-b)^2} (1+A)^{-3/2}$$

and

$$\begin{cases} b = \rho^2(1-B^2), & p = \rho\sqrt{1-B^2} \\ A = \frac{b}{1-b}, & P = BR, \quad q = \sqrt{1-B^2} \end{cases}$$

and other symbols have the same meaning as in Fermi's paper,

This relation also leads to a double-cone in the centre-of mass system as required by experimental data. In the particular case of a head-on-collision, or in the other extreme case of an edge-on-collision, our results exactly reduce to that obtained by Fermi.

4. Nuclear Disintegrations produced by α -particles of Great Energy in Nuclear Emulsions

M. V. K. APPA RAO, R. R. DANIEL and K. A. NEELAKANTAN,
Bombay.

An extensive study of nuclear disintegrations caused by α -particles of primary cosmic radiation with energies >5 BeV/nucleon, has been carried out. In a systematic survey in nuclear emulsions using 'along the track' scanning method, a total of 479 α -particles corresponding to a total track length of 40.843 meters and 242 interactions were obtained. The mean free path for nuclear interaction in nuclear emulsions is found to be 16.88 ± 1.08 cms., (66.5 ± 4.2 gms./cm²). This corresponds to an effective nuclear radius of $r_0 = 1.149 \pm 0.037 \times 10^{-13}$ cms. A method using the angular distribution of shower particles has been developed to distinguish protons that have not taken part in nuclear interactions from other relativistic charged particles. Using this method an attempt has been made to deduce the proportion of events where 1, 2, 3 or 4 nucleons take part in interactions. It is found that in about 50% of the α -induced stars in emulsions only one nucleon takes part in the interaction while in about 30% all the four nucleons interact. The mean number of nucleons taking part in interactions averaged over all stars is 2.22. A method has also been suggested to calculate the mean free path for nucleon-nucleon collisions in nuclear matter. A value of $\approx 4.7 \times 10^{-13}$ cms., is obtained.

5. Some Evidence for the Non-central Nuclear Forces

M. K. BANERJEE, M. K. PAL, and A. K. SAHA, Calcutta

Intermediate coupling calculations have been carried out for the polyads with $A = 6, 7$ and 14 using a mixture of the Majorana and the Bartlett exchange forces as the central part of the nuclear force and a mixture of the tensor and the two-particle spin-orbit interactions as the non-central part. The strengths of the central and non-central forces were determined by matching the magnetic moment of the ground state of Li^6 and the spacings of the first two excited levels of the same nucleus. The same Hamiltonian gave the correct doublet splitting in the case of Py^7 but the predicted positions of the other levels were far too low. The correct magnetic moment of the ground state of N^{14} could only be obtained by changing the strengths of the non-central forces. But even then the ground state continued to be predominantly ^{13}S state, whereas the large ft -value of $\text{C}^{14} - \text{N}^{14}$ beta-decay requires it to be a predominantly D-state.

An interesting result of this work was that the non-central force was found to be necessarily a mixture of the tensor and the two-particle spin-orbit interactions. None of these alone will be able to give the correct magnetic moments of Li^6 and N^{14} and the correct doublet spacing in the case of odd- A nuclei.

An extension of the work has been made to the case of energy level determination of Be^8 . The Hamiltonian is at present being scrutinised by testing if it can reproduce

the observed properties of the ground state of deuteron, specially the quadrupole moment.

6. On Neutron Proton Pairing Interaction in Heavy Nuclei

S. N. GHOSHAL and A. N. SAXENA, Calcutta.

The effect of neutron-proton pairing interaction between the last odd neutron and the last odd proton in the outermost neutron and proton shells of a nucleus has been demonstrated by the last neutron binding energy and the last proton binding energy plots in the heavy nuclei. The n - p pairing interaction λ has been estimated for nuclei in the region $Z > 82$ and $N > 126$ and it has been successfully used to explain the neutron and proton binding energy plots. λ seems to decrease with increase in the difference between neutron and proton numbers in the outermost neutron and proton shells respectively for nuclei in the region of $Z > 82$ and $N > 126$.

7. Setting up of a Spin-Echo Apparatus

B. M. BANERJEE and S. K. GHOSH ROY, Calcutta.

A pulsed $r.f.$ generator together with a Bloch Head has been set up for the study of spin-echo signal.

8. Measurement of Relaxation Times with a Nuclear Magnetic Resonance Apparatus

B. M. BANERJEE, T. P. DAS, D. K. ROY, S. K. GHOSH ROY and
T. GHOSH, Calcutta.

A comparative study of different methods of Measuring Relaxation time of liquids has been made. Actual data for various liquid compounds have been determined by Purcell's technique and also by Autodyne technique.

9. Quadrupolar Nuclear spin-lattice relaxation Calculation for body centred cubic lattice

T. P. DAS, D. K. ROY and S. K. GHOSH ROY, Calcutta.

Kranendonk's method for theoretical evaluation of quadrupolar nuclear spin-lattice relaxation in crystalline solid has been extended to the case of body centred cubic lattice like CsCl.

10. Spin-Echo Modulation Due to Magnetic dipole interaction between a closely interacting pair of Nuclei in Crystals

T. P. DAS and S. K. GHOSH ROY, Calcutta.

It is shown that the strong interaction between a closely interacting pair of nuclei subject to resonance simultaneously produces a modulation of the spin-echo pattern

for these nuclei. It is discussed how we obtain information regarding the structure of the crystal from an analysis of their modulation pattern.

11. Spin Echoes in the presence of non-axially symmetric quadrupole interaction in crystals

T. P. DAS and D. K. ROY, Calcutta.

Spin-echo amplitudes for spin $I = 1, 3/2$ and $5/2$ have been worked out in the presence of weak electric quadrupole interaction in crystals with non-axial electric field gradients. The effects of 1st and 2nd order perturbation due to the quadrupole interaction in causing a modulation of the spin-echo signals have been analysed in detail in comparison with the splitting and shift effects they cause in the steady experiment.

12. Stimulated Echo Calculation for Pure Quadrupolar and Strong Quadrupolar Weak Zeeman Case in Crystals

T. GHOSH, Calcutta.

Following density Matrix Method of calculating spin-echo signal, stimulated echo term with three pulses has been calculated for crystals having pure Quadrupolar & Strong quadrupolar, weak Zeeman interaction.

13. Spin-Echo Calculation for three Spin System

T. GHOSH, Calcutta.

Spin-Echo calculation has been done for a three spin system and thus echo amplitude modulation has been obtained corresponding to the steady case done by Bersohn.

14. Cloud chamber evidence of an S-particle of mass $>1100 m_e$

S. NARANAN, P. V. RAMANAMURTY, A. B. SAHAR, SIDDHESHWAR LAL and
A. SUBRAMANIAN, Bombay.

In a double multiplate cloud chamber arrangement triggered for penetrating showers at Ootacamund (7,500 ft. above sea level), an S-particle of mass $>1100 m_e$ has been observed. The particle, after traversing four lead plates (16 gms cm^{-2} each) comes to rest in the fifth plate and decays into a secondary which penetrates at least seven lead plates, and enters the next at minimum ionisation. The minimum range of the secondary is 145 gms cm^{-2} of lead. The lowest mass value for the S-particle, calculated from the secondary range, and assuming the secondaries to be a mu-meson and neutrino (or neutrinos), comes out as $1110 m_e$.

15. The Collision Mean Free Path of the Heavy Nuclei with $Z \geq 3$, in G-5 Nuclear Emulsions

B. M. ANAND, Hoshiarpur.

From a study of the number of nuclear disintegrations produced in a G-5 nuclear emulsion stack and the total number of tracks of heavy nuclei in the same volume of

the emulsion, the following values of the collision mean free paths of the heavy nuclei have been derived.

Heavy nuclei group.	Mean free path in grams per cm ² .
A ... $3 \leq Z \leq 5$	82 ± 18
B ... $6 \leq Z \leq 8$	49 ± 10
C ... $9 \leq Z \leq 15$	29 ± 9

16. Some Theoretical Aspects of the Cerenkov Radiation Phenomena

A. M. SAYIED and B. D. NAG, Calcutta.

A theoretical treatment of the phenomena of Cerenkov radiation based on the classical phenomenological electrodynamics as given by various authors will be discussed briefly. A treatment of the problem based on classical relativistic electro-dynamics will be presented and discussed. Some observations will be made regarding the quantum theory of the phenomena and will be compared with those obtained classically.

17. Compton Scattering of Light by Electron

D. BASU and D. P. SURAL, Calcutta.

The Thomson formula for the scattering of light by free electron differs widely from the Klein-Nishina formula, the latter agreeing very well with the experimental results. The scattering cross-section in Thomson formula remains constant with increase in the energy of the photon whereas the Klein-Nishina result agrees with that of Thomson at very low energy and then decreases rapidly with increasing photon energy. It is of some importance to know the relative influence of spin and relativity in making the Klein-Nishina cross-section so much less than the non-relativistic Thomson formula. The Klein-Nishina formula is based on the Dirac theory of the electron which incorporates the effect of spin and relativity in an inseparable way, so we approach the problem from the semi-relativistic Hamiltonian of the electron in which the influence of spin can be treated with the Pauli spin theory. This method fulfils our purpose because the terms due to relativistic correction and spin appear separately; however it has the limitation that it is not valid for large energy. In this approximation (retaining terms up to K_0^2/μ^2) the total scattering cross-section is given by

$$\phi = \phi_0 \left[1 - 2 \frac{K_0}{\mu} + \frac{26}{5} \frac{K_0^2}{\mu^2} + \frac{3}{4} \frac{K_0^2}{\mu^2} - \frac{K_0^3}{\mu^2} \right]$$

where ϕ_0 is the Thomson cross-section. (K_0 = initial energy of the photon and μ = the rest energy of the electron) The first three terms agree with that obtained from an expansion of Klein-Nishina formula. The fourth term is due to spin of the electron whereas the last term is a relativistic correction. The spin effect is thus separated from the relativity effect up to this approximation and it appears that the influence of relativity effect is much more pronounced than that of the spin in making the Compton scattering cross-section decrease with increasing energy.

18. On Pair Production by Fast Electrons

PREM KUMAR, Hoshiarpur.

Electromagnetic Cascades recorded in Nuclear Emulsions have been studied with a view to find the contribution of the Trident process in the multiplication of the cas-

cade. The mean free paths for the Trident and Pair processes have been determined in two energy ranges, 1-10 Bev and 10-100 Bev.

$$\text{High Energy} \quad \lambda_{\tau} = 2.0 \pm 1.0; \quad \lambda_{\rho} = 1.0 \pm 0.3$$

$$\text{Low energy} \quad \lambda_{\tau} = 4.0 \pm 2.0; \quad \lambda_{\rho} = 1.3 \pm 0.3$$

all measured in terms of the cascade length = 3.5 cm. in these emulsions. The results have been compared with those reported elsewhere. The development of the cascade has been compared with the theoretical pattern.

19. Scattering and cold neutrons in liquid metals and the entropy of disorder

K. S. SINGWI and S. VISWANATHAN, Bombay.

Introducing a varying degree of disorder in Mott's quasi-crystalline model of liquid metals, the change in the cold neutron scattering cross-section on melting is calculated. Mott's calculations of the change in electric conductivity on melting have been repeated on the basis of this modified model using more recent data on the latent heat of fusion. It is shown that the change in the neutron scattering cross-section in lead and the change in conductivity in sodium and potassium on melting can be explained if we assume that the entropy of disorder on melting is nearly $0.5R$, R being the gas constant. That this value is of the right order of magnitude seems to be corroborated by self-diffusion data.

20. Criticality Condition and Flux of a Swimming Pool Reactor

L. S. KOTHARI, Bombay.

Calculations to determine the critical mass of a swimming pool type reactor have been made, assuming a homogeneous, cylindrical core assembly. With an aluminium-water ratio of 0.552 and uranium enrichment of 47.1% in U^{235} isotope, the critical mass of U^{235} is found to be 2.11 kg. Both the fast and thermal flux distributions have been calculated inside the core and in the reflector. Unlike graphite and heavy water reactors, fast flux is greater than the slow flux in the core and in the centre of the core the ratio of fast to thermal flux is obtained as ~ 3.4 .

21. Variation of Critical Mass of a Swimming Pool Reactor with certain Parameters

B. M. UDGAONKAR, Bombay.

The effect of variation of a number of parameter on the critical mass of the swimming reactor discussed in the preceding paper have been studied :

- (a) Critical mass increases with increase in the age of neutron in the aluminium water mixture. An increase of nearly 2% in age produces a 10% change in the critical mass.
- (b) The variation of critical mass with different aluminium water ratios shows a minimum around 0.5,

- (c) Instead of water, other reflectors like C, Be, and BeO have been tried. BeO is found to be a better reactor than Be. Graphite lies between Be and water. Critical mass reduces to about 1.2 kg. for an infinite graphite reflector on all sides of the core.

22. Some studies of the two Nucleon Interaction

M. K. SUNDARESAN, Bombay.

The integral equation for the scattering of neutrons by protons in the singlet state at zero energy, in the lowest order Tamm-Dancoff approximation, has the following significant feature. The kernel of the equation possesses always a positive value for any value of both of its arguments. Similar kernels have been encountered in the theory of meson nucleon scattering and there it was shown that a purely positive kernel corresponds to a repulsive interaction, while a negative kernel corresponds to an attractive interaction. It appears thus at first sight that the interaction in the singlet state in the N-P system is repulsive. However, in the so-called adiabatic approximation, Levy has established that the interaction is attractive. Thus, it appears that the sign of the kernel in momentum space can be misleading: A negative kernel always implies attraction, a positive one does not necessarily imply repulsion, but it is necessary to investigate its detailed behaviour.

Clarification of this situation has been obtained by studying Fourier Transforms of certain potentials, notably the more potential. With the understanding reached from these examples, the integral equation for N-P scattering in singlet state is solved and results are found to be consistent with the postulate of a repulsive core of radius $4 \frac{\hbar}{\mu c}$ and an attractive well with Yukawa form with range $\frac{\hbar}{\mu c}$.

23. Spin-orbit Coupling in Li^7

G. ABRAHAM, Bombay.

The splittings of levels in He^6 , Li^6 , and Li^7 is calculated assuming the perturbing force to be the two-body spin-orbit force,

$$V = V_m (\vec{\sigma}_1 + \vec{\sigma}_2) (\vec{r}_1 - \vec{r}_2) \times (\vec{p}_1 - \vec{p}_2) / \hbar$$

The wave functions used for this calculation are built up from single particle wave-functions similar to those generally used in the shell model. It is found that the strength V_m of the spin-orbit force is about 1 MeV for the Li^7 ground state and about 2 MeV for the He^6 and Li^6 levels. The results are compared with those of Feingold on the tensor force and Inglis on the single-particle spin-orbit force.

24. Vacuum Polarization for particles of Spin 3/2

K. K. GUPTA, Bombay.

Vacuum polarization for particles of spin 3/2 is calculated using the Rarita-Schwinger form of Fierz-Pauli equations for particles of spin 3/2. The result is found to be linearly divergent and cannot be removed by the technique of charge renormalization.

II. APPARATUS AND INSTRUMENTS

1. Growing of Organic Phosphors for Scintillation Counters

RANGALAL BHATTACHARYYA, UMA BASU ROY and SANTIMAY CHATTERJEE,
Calcutta.

Scintillation organic phosphors like stilbene, diphenyl and anthracene have been grown by the dropping melt method in an electrically heated furnace. The melt, kept in a glass capsule, is gradually lowered into a furnace where a temperature gradient has been maintained. Regulation of current in the heating coils enables the adjustment to proper temperature range. Slow and steady lowering of the melt is effected by means of a motor geared down to the requisite speed. In the most general case the melt goes down through the furnace in about 60 hours. All sorts of mechanical shocks to the furnace have been avoided by placing the entire arrangement on shock absorbing materials. Crystals of stilbene and diphenyl upto a diameter of 1" and length 4" have been grown.

2. High Intensity Radio Frequency Ion Source

S. K. MUKHERJEE and NIRMAL K. MAJUMDAR, Calcutta.

Investigations on a high intensity proton ion source, utilising electrodeless radio-frequency discharge, are described. This is developed to provide a low voltage D. C. accelerator with a strong focussed ion beam. High plasma density was obtained by maintaining operating pressure in the discharge tube near about 10μ and by supplying large R. F. power. Special arrangements of probe and focussing electrodes together with the application of magnetic field in the vicinity of extracting electrodes, overcomes extraction limitation of ion beam and gives resolved proton ion output of more than 10 ma. Effects of magnetic field, pressure and other parameters, on the ion output, are also discussed.

3. Characteristics of the Ion source of the Calcutta Cyclotron

P. K. DUTT, A. P. PATRO, B. BASU and A. CHATTERJEE, Calcutta.

The behaviour and characteristics of the low-voltage (50 to 200 volts D.C.) capillary arc type ion-source of the Calcutta cyclotron have been studied with the arc discharge current (upto 1 ampere), arc voltage, filament temperature, and gas flow as variables.

The output ions and electrons from the source available for cyclotron acceleration were measured under various conditions of the above-mentioned parameters by inserting a molybdenum probe over the source exit hole and applying on it voltages varying from -360 volts to +220 volts. An estimate of the ratio of ion current/electron current under various experimental conditions relating the above variables gave an idea of the ionisation efficiency of the source.

In general, higher arc voltages yielded better ion output. But higher rates of gas flow showed a maximum, after which the total ion output actually decreased.

A 50 cycle 0.5 to 5.0 millisecond thyatron pulser utilising EG 67 tubes was constructed for pulsing the ion source in order to eliminate the r.f. pick-ups, and also to take

advantage of higher voltages. The characteristics of the pulsed ion-source were also studied oscillographically with arc voltage, arc discharge current, electron and ion output of the source. These corroborated the d.c. measurements.

Further observations of the characteristics of the newly designed hooded arc were made as a function of the above parameters. The hooded arc actually yielded an increased amount of beam current ; other features appear to be consistent with the previous measurements.

Some points of interest regarding the characteristics of the arc have been studied spectroscopically.

4. Spectroscopic measurements of the characteristics of the Calcutta Cyclotron Ion-source.

A. CHATTERJEE and P. K. DUTT, Calcutta.

The object of the present studies is to have an estimate of the relative abundance of the atomic and molecular ions in the source proper and to study its variation as a function of the arc parameters. The importance of these measurements lies in the fact that publications by various workers on these points employing other methods of detection have reported widely different values of the H^+/H_2^+ or D^+/D_2^+ ions.

There is also no reported spectroscopic data on the ion source of other cyclotrons.

Spectrograms were taken within the following normally operating conditions and ranges;

Arc voltage: 50-200 volts; total arc current : 0.25-5.0 amperes; gas flow: 0.02-2.0 mgm./min.

Differences in the atomic to molecular ratio have been found by changing the above parameters.

5. Magnetic Switching Device

H. B. MOHANTI, Kharagpur.

Magnetic ferrites in the form of small toroidal cores which have the characteristics of a rectangular hysteresis loop, have been successfully attempted to be utilised for switching device. A toroidal core of size O.D. = .551", I.D. = .375" and thickness = .187" was used. Signals were applied with the help of a pulser unit consisting of two multivibrators and one power amplifier. The core has three windings of which one is for a train of pulses to magnetise the core and the other two are for input and output.

A pulse of repetition frequency 50 KC/S was switched on and off with the help of this device, the switching time being 2μ secs. The circuit has one important advantage in that the magnetising pulses can be stored in the magnetic medium and therefore can be cut off without loss of data. There is a possibility for the device of taking the place of valve switching devices for some of the applications as it is simple and inexpensive, and it provides the degree of stability and reliability of operation required.

6. Theory of an Electrostatic Time of Flight Mass Spectrometer

P. K. DUTT and B. D. NAG, Calcutta.

A theoretical expression for the nature of variation of Electrostatic field with time, i.e. the pulse-shape, required for bunching ions of a particular e/m in a field-free space,

has been developed to the first order approximation. This expression arose out of our work on time-of-flight mass-spectrometry. A graphical solution for the expression has been given. The trajectories of the particles of a particular e/m in the field-free space have been drawn after it has been subjected to the pulse-acceleration. It is shown from the nature of the graphs that exact point bunching of ions in space is not physically attainable. An expression for the resolving power has been given.

The space-charge effects, and the angular divergence of the initial beam have been considered in this present paper. An experimental arrangement of pulsed voltages and drift tubes have been made according to theoretical calculations. Preliminary results with this apparatus have been obtained.

7. A two directional focussing mass spectrometer

S. B. KARMOHAPATRA, Calcutta.

With a radially inhomogeneous magnetic field of the shape $H = H_0 \left(\frac{r_0}{r} \right)^n$, where H is the field at radius r , H_0 is the field at the central orbit, having radius r_0 , and field index, $n = - \frac{r}{H} \frac{dH}{dr}$, charged particles will be focussed at an angle $\sqrt{2} \pi$, when $0 \leq n < 1$. Any sector magnet, having an angle less than $\sqrt{2}\pi$ may be used for mass spectrometry, for which ion-sources, detectors are to be kept outside the field.

A symmetrical magnetic analyser with a cone angle $\tan^{-1} \frac{nb}{r_0}$, where b is half-gap width, and sector angle 180° has been studied with the pole edges shaped circularly to a curvature of radius R , to attain second order radial and first order axial focussing. Design considerations show that for the distance (l) of the source or the detector from the pole edge, which is $0.7r_0$, R will be $0.343r_0$.

A cone angle $2^\circ.1$ is chosen to get $n = 0.5$. The magnet gap width is $1''$ at the central orbit $r_0 (= 7'')$. Design studies and preliminary experimental results will be presented.

III. OPTICS AND SPECTROSCOPY

1. Calculation of Ultrasonic Dispersion Frequency and Dispersed Velocity in gases from Molecular Spectra

S. K. K. JATKAR and D. D. DESHPANDE, Poona.

In the present paper, the ultrasonic dispersion has been quantitatively found to be due to London's intermolecular forces calculated from observed molecular vibration frequencies in infrared and Raman spectra. The dispersed velocity can be calculated by finding the heat capacity from spectroscopic data. The contribution to the heat capacity from infrared vibration frequencies is found to be knocked out stepwise with increase of ultrasonic frequency.

2. Energies and Products of Dissociation in the Chlorides of Ti, Cr, Mn, Fe, Co, and Ni

(MRS.) B. KANAKA DURGAVATHI RAO, Jealgora
and

DR. V. RAMAKRISHNA RAO, Waltair.

From an analysis of the diatomic spectra of the chlorides of Ti, Cr, Mn, Fe, Co, and Ni the energies and products of dissociation in their high multiplicity transitions have been determined.

It is observed that the E_{ion} values for Cr, Mn and Fe of the same order of magnitude (1.97, 1.98, 1.91 e.v. respectively) and relate to the even configuration low states. In the case of Ti and Ni the E_{ion} values are very high (2.1 and 3.2 e.v. almost the first ionization Potential in Ti). In Co the E_{ion} is only 0.95 e.v. almost corresponding to the lowest configuration itself. The case of vanadium for which data are not available, may be expected to be similar.

3. The Near Ultraviolet Absorption Spectrum of Ethylbenzoate

N. V. R. APPA RAO and V. RAMAKRISHNA RAO, Waltair.

The absorption spectrum of Ethylbenzoate was found to consist of eight diffuse bands in the region 2769.9 to 2630.6 A.U. Taking the strongest band at 2769.9 A.U. as (0, 0) we could interpret the bands on the basis of three fundamentals, 314, 948 and 1298 cm^{-1} . The first two may be attributed to the totally symmetric carbon vibrations in the phenyl radical; while the 1298 cm^{-1} frequency may be attributed to the C-O vibration in the upper state. This system may be attributed to the $\pi \rightarrow \pi^*$ transition analogous to the long wave length spectra of substituted benzenes.

The bands due to the $n \rightarrow \pi^*$ transition in C=O appear to be obtained by us in emission spectrum in the form of three pairs of bands in the region 4603.8 to 3671.5 A.U. A separation of about 24 cm^{-1} in the bands of each pair represents the Rotational Head separation. The mean separation between successive pairs of 1715 cm^{-1} agrees well with the strong Raman line 1724 cm^{-1} and is due to the C=O vibration in the ground state. This system may be attributed to the $n \rightarrow \pi^*$ transition in C=O radical.

4. Transition from Aromatic to Aliphatic Type of Absorption in the Spectra of Benzoquinone

R. K. ASUNDI and RAMA SHANKAR SINGH, Banaras.

The vapour absorption spectrum of benzoquinone exhibits three band systems—one in the visible and two in the ultra-violet regions. On the basis of the analogy between such molecules and benzene, the two ultra-violet systems should be due to allowed transition with B_{2u} and B_{1u} as the excited levels. This is borne out by the analysis of these bands. Similarly the visible bands should be due to a symmetry allowed but at most a spin forbidden transition. This, however, is not substantiated by the gross structure analysis of the bands. On the other hand, the analysis proves that the bands are due to a symmetry forbidden transition rendered allowed by the excitation of a nontotally symmetric vibration. Thus the benzene analogy fails for the visible bands.

Symmetry considerations and the fact that the 'forbidden' transition is rendered 'allowed' by the excitation of a ν_2 type vibration show that the excited level of the visible bands is A_{1g} . This result shows that a correspondence exists between this level and the excited level involved in the visible absorption spectra of aliphatic aldehydes and ketones. In the latter compounds the absorption is known to be due to a transition in which a loosely bound electron occupying a non-bonding orbital lying in the molecular plane and across the C=O direction is excited to a molecular orbital with a node in the plane of the molecule. Such a transition is shown to be a forbidden one for a molecule of C_{2v} or C_{2h} symmetry. For a similar forbidden transition in a molecule of D_{2h} symmetry e.g. benzophenone, the excited level has to be A_{1g} in agreement

with the above conclusion. Thus the spectra of benzoquinone indicate a gradual transition from the aromatic ring character in the ultra-violet to the aliphatic ketone character in the visible system.

5. The Near Ultra-violet Absorption Spectrum of *p*-chlorophenol

R. K. ASUNDI and B. D. JOSHI, Banaras.

The absorption spectrum of *p*-chlorophenol vapour was photographed using the Hilger Large quartz spectrograph at different temperatures ranging from 18°C. It consists of discrete bands extending from 3000Å to 2550Å. The band at 34821 cm⁻¹ is assigned as the 0, 0 band of the allowed electronic transition A₁ - B₁. The prominent bands are mostly combinations of the excited state frequencies 351, 798 and 1053 cm⁻¹ of which 798 and 1053 cm⁻¹ show progressions. In addition to these there occur upper state frequencies 540 and 1272 cm⁻¹. The ground state frequencies 264, 378, 441, 510, 640 and 838 cm⁻¹ have been observed. Most of the prominent bands are accompanied by "companions" on the longer wavelength side at separations of 32, 2 × 32, 82, 82—32, 82—2 × 32 and sometimes of 10 cm⁻¹.

6. Luminescence Spectra of Thallous Chloride under Cathode-ray Excitation

S. C. SEN, Khargpur.

Luminescence spectra, under cathode ray excitation of thallous chloride containing different percentages of potassium chloride have been investigated at liquid nitrogen temperature. Emissions due to thallous chloride extend from 6350 to 6150 Å.U. and 4900 to 4200 Å.U. consisting of a number of diffuse bands; but the emission spectra due to thallous chloride solidified from melt at 500°C in air, is different, from that of normal thallous chloride. In this case the longer wavelength bands are stronger. Introduction of potassium chloride has been found to have quenching effects, on the fluorescence of thallous chloride, so that at 1% concentration, the emission due to thallous chloride is completely replaced by an emission which appears to be due to potassium with its energy levels modified in the thallous chloride lattice.

7. Force constants of PH₄ Molecule

K. VENKATESWARLU and M. G. KRISHNA PILLAY, Annamalainagar.

Force constants of the PH₄ molecule belonging to the T_d group are evaluated by the Wilson's method and the values are in md/Å 3.1540, 0.2900 or 0.2472, 0.2790 or —0.1010, and 0.0379 or 0.0165 for f_d , f_a , f_{da} and f_{aa} respectively.

8. Force constants of GeBr₃ and SnCl₃

K. VENKATESWARLU and S. SUNDARAM, Annamalainagar.

The groups GeBr₃ and SnCl₃ having pyramidal structures and belonging to the point group C_{3v} have been treated by the Wilson's F—G matrix method. Using a potential function involving four force constants, the elements of the potential and kinetic energy matrices have been worked out. The bond angles in both the cases have been calculated,

using Herzberg's relation, from the frequencies as no observed data are available. The force constants f_d , f_{dd} , f_a and f_{aa} in md/A respectively have been evaluated as 2.1730, 0.8260, 0.1638 and -0.0451 for GeBr_3 and 2.3360, 0.5360, 0.1336 and -0.0253 for SnCl_3 . Using the Badger's rule the Ge-Br and Sn-Cl distances as calculated from the f_d values obtained in this investigation are 2.31 and 2.29 Å respectively and they are in very close agreement with the observed values of 2.32 and 2.30 in the two cases.

9. On the Relative Efficiency of some Potential Energy Expressions

M. R. KATTI and N. R. TAWDE, Dharwar.

Tawde and Gopalkrishnan (Ind. J. Phys. 28, 469, 1954) have already reported results on the role of potential energy expression of Hulbert-Hirschfelder in the derivation of transition probabilities in C_2 Swan System. They indicated the extension of its application to N_2 molecule for verification of their conclusions. This has been done in this paper and it has been concluded that in spite of the function employing all the observed constants, it is in no way better than Morse Expression in confirming to the values of transition probabilities predicted from rigorous mathematical considerations or to those derived experimentally.

10. On the Workability of Lotmar's Potential Energy Function

N. V. GEJJI and N. R. TAWDE, Dharwar.

Kronig has suggested that when Morse expression is inadequate, the potential energy of many diatomic molecules can be expressed by a more general expression like that of Rosen and Morse. This expression as improved by Lotmar has been studied in this paper and the condition for its workability has been derived. When this condition is applied to electronic states of some diatomic molecules, whose constants are known, it is found that the expression has a very limited applicability. However, in a few cases where it works, it yields values of dissociation energy in better approximation with true values than those derived from the method of extrapolation.

11. Problems of the theoretical transition probability in certain correlated molecules

P. V. CHANDRATREYA, Bombay and N. R. TAWDE, Dharwar.

Evidence of quantitative intensity distribution as a function of internuclear separation Δr in electronic states in a set of molecular band systems has been brought to bear on the problem of the derivation of internuclear distance r , in upper and lower electronic states, for molecules where r is not known. These estimated values have been utilised to compute, in the case of LaO molecule, the transition probabilities of the yellow system ($B^2\Sigma - x^2\Sigma$), by using the analytical method of Hutchisson. These have been compared with the observed experimental data on intensities. In the light of these findings, significance of the use of the above procedures has been discussed.

12. Variation in Intensity of the night air Glow at Poona

M. W. CHIPLONKAR and P. V. KULKARNI, Poona.

During the clear season of 1954-55 intensity measurements of the night air glow at the zenith were carried out on clear & moonless nights at Poona. A photomultiplier type of photometer & a C.R.O. with a high gain amplifier were used. Observations

were taken at an interval of 15 minutes & about 10 series of complete night sky observations were obtained. All the curves show a maximum near about midnight. The maximum intensity is approximately 20% more than the average intensity. This type of variation is in agreement with the recent measurements of Roach & Barbier and Roach & Pettit; but is exactly opposite to the one observed by photographic photometry by Karandikar in 1932-33 at Poona.

13. The Scintillations of Stars

M. W. CHIPLONKAR and P. V. KULKARNI, Poona

Experiments have been conducted at Poona (lat. N $18^{\circ}31'$; long. E $72^{\circ}52'$) with a view to investigate the nature of this phenomenon in the tropics. A large aperture camera, photomultiplier tube, high gain amplifier & a C.R.O. were used for this purpose. Photographic records were obtained of the fluctuations in position of the C.R.O. spot, when the camera was pointed towards stars of first and higher magnitudes at different altitudes. A significant conclusion is that the frequency of scintillation increases with altitude. These and other results are discussed and compared with those obtained elsewhere.

14. Further measurements of the intensity of zenith sky during twilight using a photoelectric photometer

M. W. CHIPLONKAR and P. V. KULKARNI, Poona.

In a number of previous communications, intensity measurements of the zenith sky during twilight, at Poona and Mt. Sinhgad, using visual methods were reported. In the present communication we have adopted the method of photoelectric photometry, as it is more objective. The new photometer consisted of a photomultiplier tube, monochromatic filters, a high gain D.C. amplifier & C.R.O.

In all 26 morning & 24 evening sets of readings were secured during the period November 1954 to April 1955. As was observed previously although the morning twilight intensities are on the whole less than those during the evening twilight, the individual curves of intensity against depression of the sun below the horizon, do not show significant differences from day to day. The present curves are very much smoother than those obtained by the visual method, the maximum standard deviation for the new green curve at $\theta = 6^{\circ}$ being ± 0.1 as against ± 1.9 for $\theta = 6^{\circ}$ of the old green curve.

15. The method of Trigonometrical Series in calculating the modification of Intensity of Monochromatic Radiation due to Multiple Compton Scattering

K. K. SEN, Chandernagore.

The method of solutions by use of trigonometrical series developed in previous papers for treatment of radiation scattering problems in electron atmosphere, has been further applied to work out the problem of modification of intensity upto the second order, in stellar atmosphere of slowly moving electrons. The primary radiation at the photospheric level, has been assumed to be monochromatic which is represented by δ -function. This case as is well known is of fundamental importance. The emergent

intensity at the outer surface has been calculated for a particular value of optical thickness. The method has been checked by independent calculation of the first order intensity and comparison with Chandrasekhar's calculations made differently. It is shown that the second order calculations considerably modify those of the first order.

16. Exact solution of transfer Equations in the Milne-Eddington Model for non-coherent Scattering due to Interlocking of principal Lines—By the Method of Laplace Transforms

SANTI RANJAN DAS GUPTA, Calcutta.

The transfer equation in the Milne-Eddington Model for non-coherent scattering arising out of interlocking of principal lines have been exactly solved by the method of Laplace transforms and the emergent intensity $I(0, \mu)$ has been expressed in analytically consistent explicit functional forms for the entire complex μ -plane.

Here numerical integrations have been avoided and solutions in explicit functional forms obtained by two simple and elegant curve fittings which can be made correct up to any desired degree of accuracy. The solutions for the triplets are given here.

It may be mentioned that a very simple explicit solution for the grey case has also been obtained agreeing with the numerical values tabulated by Chandrasekhar and Breen.

Here it has been necessary to borrow results from my previous solutions for grey and coherent scattering obtained by the same method.

The explicit functional form for the present case is given below:

The emergent intensity in the r th line is given by

$$I_r(0, \mu) = a + b\mu + I_r^*(0, \mu), \text{ where}$$

$$\begin{aligned} I_r^*(0, \mu) &= (1-\epsilon) \frac{\alpha_r}{1+\eta_r} \sum \eta_p H_p^*(\mu), \text{ and } H_{pr}^*(z) \text{ is given by} \\ \exp \left[h(z) + f(z) \ln \frac{z+1}{z} \right] &\left[1 + z \ln \frac{z+1}{z} \right] H_{pr}^*(z) \\ &= K_{pr} + \delta_{pr} \left\{ \bar{Q}^0(z) + \bar{P}^0(z) \ln \frac{z+1}{z} + g_r(z) \sum \frac{\bar{C}_{1s}}{z + \rho_{1s}} \right\} \\ &+ \beta_{pr} \left\{ \bar{h}^0(z) + \bar{f}^0(z) \ln \frac{z+1}{z} + \sum_{u=1}^4 \sum_{s=1} \frac{f_{ru}(z) \bar{C}_{us}}{z + \rho_{us}} \right\} \end{aligned}$$

Here K_{pr} , β_{pr} , ρ_{ns} , \bar{C}_{us} are constants & $h(z)$, $f(z)$, $g(z)$, $P(z)$, $Q(z)$ are all determinable polynomials. δ_{pr} is the Kronecker delta.

IV. X-RAY AND CRYSTALLOGRAPHY

1. The paramagnetism of colour centres produced by X-rays in some glasses

AMALENDU CHOUDHURY, Khargpur.

A torsional microbalance has been set up to study the paramagnetism developed in alkali halides and similar solids, due to the production of colour centres by X-rays.

Arrangement has been made to colour the sample and to bleach it *in situ*, without removing it from the balance. Most of the glasses as will luminesce under X-rays and develop colour centres, might show paramagnetism. Measurement with pyrex glass, soda glass and polystyrene have been made with a view to find out, the suitability of their use as container material in the above mentioned investigation. It has been found that pyrex glass as well as soda glass become less diamagnetic, in other words they acquire paramagnetism on X-ray irradiation. When heated to about 300°C the acquired paramagnetism is lost. Polystyrene has been found not to develop colour centres or acquire any paramagnetism.

2. Delayed Thermoluminescence in Sodium Chloride under Cathode-ray Excitation

A. L. LASKAR, Khargpur.

Thermoluminescence of pure sodium chloride (Harshaw sample) has been studied by exciting it with cathode rays at liquid nitrogen and higher temperatures. The experiments were performed with comparatively higher rate of heating (2–5 °C/sec.) in order to obtain higher intensity of glow peaks and for this the phosphor was used in the form of a thin layer of fine powder. It has been observed that the sample gives three glow peaks at 165, 240 and 608°K when excited at liquid nitrogen temperature. If the sample is allowed to decay for different intervals of time before heating, it is found that the glow peaks shift uniformly towards lower temperatures. The thermoluminescence of the sample excited at room temperature and then cooled to liquid nitrogen temperature was also studied with or without optical stimulation, but no trace of low temperature glow peaks could be observed in the corresponding thermoluminescence curve. This result indicates the absence of retrapping of the electrons released from deeper trap into shallow ones.

3. Temperature Dependence of Energy Transfer in organic Phosphors

J. SHARMA and M. L. BHAUMIK, Kharagpur.

It has been observed that in a system of diphenylanthracene (.01%), when excited by X-rays, most of the energy absorbed by the parent lattice is transferred to the anthracene molecules, thereby yielding strong anthracene emissions along with small amount of emission due to diphenyl. The intensity of emissions due to anthracene and diphenyl have simultaneously been measured by a RCA 931A and a RCA 1 P 28 photomultiplier tube respectively, with necessary filters, at different temperatures between 150°K to 350°K. It has been found that in both the cases, the intensity of emission gradually decreases with increase of temperature till the melting point is reached when it suddenly reduces to a comparatively low level in the liquid state. These preliminary results indicate that the efficiency of energy transfer mechanism is temperature dependent and persists even in the molten state. Detailed investigation is in progress.

4. Dielectric Changes in Zinc Sulphide Phosphors under X-ray Excitation

K. V. RAO, Kharagpur.

A recording type of oscillator bridge after Carlick and Gibson (1947) has been constructed and set up. The frequency of the oscillator is 4.5 Mc./sec.; the sensitivity of the bridge is 0.01 $\mu\mu fd$ for dielectric constant and that for dielectric loss it

is 4.0 K Ω mm. in terms of equivalent parallel resistances. Luminescent variety zinc sulphide (copper activated, B.D.H.) was excited by X-rays and during the after-glow decay, corresponding changes in dielectric constant and loss were recorded photographically upto 200 secs. Phosphorescence decay curve was also recorded separately.

Similar measurements were made with zinc sulphide dispersed in transformer oil and in polystyrene. Preliminary results of this investigation have been discussed in the light of filling and emptying of the electron traps inside the phosphor. Decay of dielectric constant changes have been found to be intimately connected with the decay in the number of trapped electrons. The changes in dielectric loss have better correspondence with the number of trapped electrons in the case of zinc sulphide—transformer oil system while such a correspondence is lacking for zinc sulphide—polystyrene system. Results indicate the possibility that dielectric loss will also be related to the number of trapped electrons, provided the effects due to surface polarisation and contact points can be avoided.

5. On the Nature of Extra Reflections in the Laue Photographs of some Diamonds of known relative Fluorescence Efficiencies

S. C. SARKAR and S. N. SEN, Calcutta.

The positions and approximate relative intensities of extra spots accompanying the (111) reflections in the Laue photographs of eleven specimens of diamond have been determined using a Seifert X-ray tube provided with a copper target and nickel filter, and running at 30 KV, 28 mA. In order to measure the directions of extra reflections accurately in some cases the front surface of the crystals was dusted with powdered NaCl, so that the Debye-Scherrer pattern of NaCl was superimposed on the Laue photographs. The specimens studied are those used by Bishui (1950, 52) in previous investigations on the relative intensities of the fluorescence band at 4156 Å and on the ultraviolet absorption limits, excepting the specimens DII, DIII and DV used by him.

The results show that all these specimens excepting D VI possess partial mosaic structure, so that they produce extra reflections from (111) planes with different intensities in the direction making an angle $2\theta_E$ with the incident rays when the disorientation from the Bragg angle θ_B is less than 3° . It is observed that neither the intensities of these extra reflections nor those of the extra reflections in other directions observed in the Laue photographs of some of these crystals can be correlated either with the intensity of the band at 4156 Å or with the impurity present in the crystals.

6. Absorption Coefficient of a mixed Powder Specimen

G. B. MITRA and A. K. CHAUDHURI, Kharagpur.

The absorption coefficient of a mixed powder specimen containing two components is usually derived by considering the mass absorption of the components. In this derivation, the distribution as well as the particle size of the components are not taken into account. In this work, these two factors have been given full consideration and a straightforward calculation has been made. It has been supposed that each elementary portion of the incident radiation encounters n particles in its path of which x particles belong to one of the types and $n-x$ particles belong to the other type. The probability of such a situation follows the binomial distribution.

The average value of the intensity of the emergent radiation has been calculated by assuming normal approximation to the binomial distribution. The resultant absorption coefficient has been found to agree with the previously obtained expression when the particle size is very small. When the particle size is appreciable, the resultant absorption coefficient is found to be dependent upon the particle size. The fluctuation in the value of the absorption coefficient is also found to be appreciable only when the particle size is rather big.

7. Origin of Extra Graphite Bands in Amorphous Carbon

G. B. MITRA and R. G. CHATTERJI, Kharagpur.

The origin of the two recently observed bands at 7.11 A.U. and 20 A.U. in the X-ray diffraction photographs of amorphous carbon has been discussed. The 20 A.U. band has been ascribed to particle size scattering. The unit cell parameters of parent substances have been critically analysed to find if some remnants of these give rise to the 7.11 A.U. band in the resultant carbon blacks. It has been concluded that the origin of the 7.11 A.U. band cannot be ascribed to any residual structure of the parent substance. The origin of this band has been attributed to some sinusoidal defect in the near graphitic arrangement of atoms in carbon black. Preliminary studies in radial distribution of atoms has revealed that it is the structure factor that is varying sinusoidally and not the spacing.

8. X-Ray Diffraction Study of α -Yohimbine

G. B. MITRA and M. G. BASAK, Kharagpur.

The physiologically important Yohimbine alkaloids have been taken up for study by the X-ray diffraction method and α -Yohimbine has been studied in the first instance. Since it has not yet been possible to grow a single crystal of α -Yohimbine, only the powder diffraction technique has been utilised. The powder diffraction pattern was interpreted by a method based on the graphical method due to Ito. The reciprocals of three of the observed spacings were tentatively accepted to be the cell edges of the reciprocal lattice. Angles of the reciprocal lattice were determined with the help of these values by selecting pairs of spacings which are equidistant from some mean value. After several trials a set of values for the unit cell in the reciprocal space was obtained which accounted for all the spacings. From these the unit cell of α -Yohimbine has been found out to be triclinic in nature having the following constants :—

$$\begin{array}{lll} a = 5.550 \text{ A.U.}, & b = 8.888 \text{ A.U.}, & c = 15.520 \text{ A.U.}, \\ \alpha = 102^\circ 48' & \beta = 135^\circ & \gamma = 105^\circ 12' \end{array}$$

The space group is C_2^1 with one molecule per unit cell.

9. Layer Disorders in Kaolinite

G. B. MITRA, Kharagpur.

Several samples of kaolinite from Singbhum, India, were examined by the X-ray powder diffraction method. The diffraction patterns were microphotometered and

experimental line broadenings were obtained from the resulting microphotometric traces. The geometrical broadening was eliminated by subtracting the broadening of quartz powder lines at neighbouring angles. Particle size broadening was determined with the help of a formula due to Wilson. By eliminating geometrical and particle size broadenings from the experimental line broadenings, the broadening due to lattice defects were obtained. By studying such defects it has been concluded that (1) a fraction of the lattice has defective layers in so much so that the layers are randomly oriented with respect to each other keeping the inter layer distance constant and (2) the layers are shifted with respect to their neighbours in the 'b' direction by an amount of $1/3$ or $2/3$ the lattice parameter in the same direction. Moreover, there also seems to be some interlayer defects.

10. Crystal Class of Anhydrous Borax

B. K. BANERJEE, Calcutta.

During the phase-transformation study of sodium diborate during thermal treatments, it was found that there was an abrupt crystallisation in the temperature zone of 675°C of the amorphous phase of $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ which was formed, when it was heated above 400°C . The chemical composition of that specimen which was formed during heating upto 675°C , indicated it to be anhydrous borax. The systematic X-ray study of the above specimen was made with the help of $\text{Cu}-\text{K}_\alpha$ -radiation. As no single crystal of appreciable size was found, the structural details of the above product was found out by the application of the method suggested by Lipson. This crystalline variety of anhydrous borax was found to have an orthorhombic symmetry with the axial parameters as $a=6.468 \text{ \AA}$, $b=8.720 \text{ \AA}$ and $c=11.54 \text{ \AA}$. The density of anhydrous borax, together with the above cell dimensions, allowed only 4 molecules in the unit cell. There were no systematic absence of any kind of reflections except for $l \neq 2n$, in the X-ray diffraction pattern, which showed the most suitable space-group for anhydrous borax to be D_2^2 or $p/222_1$.

11. Contribution of the Electron Gas to the Elastic Constants of Cubic and Tetragonal Metals

B. V. GOKHALE, Kharagpur.

Born-von Karman lattice dynamics has been applied in writing down the equations of motion of atoms in metals of body-centered cubic, face-centered cubic and simple tetragonal systems. In the case of the cubic systems, interactions with the first and second nearest neighbors have been considered. For the tetragonal case, the interactions of an atom with its first four nearest neighbors have been taken into account. Comparing these equations with the corresponding equations of motion in the continuous case of elastic vibrations, the force-constants have been expressed in terms of the elastic constants. This procedure automatically leads to the "Cauchy relations". The effect of the free electrons is then considered to give an additional pressure term in the equations of motion. With this modification the elastic constants are found to depend upon the bulk modulus of the electron gas as well as upon the force-constants. The Cauchy relations are no longer valid. This appears to be supported by experimental evidence

12. Small Fourier terms in Crystal Structure Analysis and Renniger Effect

K. Banerjee, Allahabad.

While carrying out of crystal structure analysis by the Fourier synthesis method the correct determinations of the structure factors of weak planes are of importance on account of their large number so much so that any systematic source of error may cause appreciable errors in the synthesised structure.

If the end point of a reciprocal lattice vector which is the sum of two other reciprocal lattice vectors lies on the sphere of reflection simultaneously with the end point of one of the component vectors and if the crystal planes corresponding to the latter two vectors are not absent planes, Renniger effect will be observed.

In cases where the resultant reciprocal vector does not correspond to an absent plane, Renniger effect should naturally overlap with the ordinary reflection and consequently in the measurement of the integrated intensities of such planes correction due to this effect is necessary. On account of the finite divergence of the Bragg angle particularly in a mosaic crystal, it is found that reciprocal vector of any plane of not very low indices can be represented as the vector sum occasionally of a few vector pairs. The contributions of these vector pairs are thus added up to the real integrated intensity. In many cases of weak planes corrections come up to as much as the actual reflections from these planes.

V. RADIOPHYSICS AND IONOSPHERE STUDIES

1. A new type of *M*-echo from the Ionosphere

R. SATYANARAYANA, K. BAKHRU and S. R. KHASTGIR, Banaras.

In our experimental studies of the polarization of the echoes from the ionospheric layers by using Ratcliffe & White's circularly polarized receiver, the oscillograms taken at night of the reflected pulses revealed a type of echo from the ionosphere which had not been previously observed. With a frequency of 3 Mc/s, sent out from a pulse-transmitter, a number of oscillograms showed that in addition to the spurious E-echo, which was of rapidly varying intensity and the magnetically split F-echoes, there was distinct evidence of a *left handed* echo corresponding to an equivalent height, $2F-E$. It appeared that at the time of the observation the up-going wave penetrated the E-region and after reaching the F-region got reflected from it and that the reflected wave, on coming down, suffered reflection from the E-region and the upgoing reflected wave was once again reflected back by the F-region to reach the ground after penetrating the E-region. When examined by the polarized receiver, this type of multiple reflection, once from the E-region and twice from the F-region was found to yield a *left handed* echo along with the E-echo which was also found to be predominantly *left handed* in polarization. As the observed echo corresponding to the equivalent height, $2F-E$, was definitely left-handed, it was considered quite different from the right-handed M-echo which had previously been observed by Ratcliffe & White and the echo has been designated M-ordinary-echo (or M_o -echo).

The interpretations of the left-handed E_s and the M_o -echo observed at night with 3Mc/s-waves are briefly as follows:

The sporadic E-region may be, at times, of sufficient electron density causing magneto-ionic splitting, the ordinary component being usually reflected downwards and the extraordinary being almost completely absorbed. This would explain the pronounced left-handed polarization of the E_s -echo. Due to the irregular distribution of ion-clouds, changing at random in the sporadic E-region, the E_s -ionization may at times be 'patchy' so that the upgoing wave passes through the E_s -region and on reaching the F-region suffers magneto-ionic splitting, giving ordinary and extraordinary reflected components which after passing through the E_s -region, when it is 'patchy', are returned to the ground. In view of the random changes in the distribution of ion-clouds in the E-region, the observed magnetically split F-echoes are to be considered as *statistical*, when they are present along with the E_s -echo.

At times, however, the ordinary component suffers partial reflection at the sporadic E-region. In such cases of partial reflection, the partially transmitted ordinary component goes up and reaches the F-region. The reflected wave from the F-region, comes down and gets either partially or totally reflected from the E_s -region. The wave thus reflected upwards is again reflected from the F-region, and when this wave is able to pass through the E_s -region which may, at times, be of comparatively less electron density, we would get an M-echo (corresponding to an equivalent height, $2F-E$) with left-handed polarization. This interpretation of the new type of M-echo is consistent with the view that the sporadic E-region has a thin-layer structure giving steady reflection and has also an irregular distribution of ion-clouds giving random scattering.

2. Global Distribution of the negative Storms in the Ionosphere

(MISS) MRINMAYEE GHOSH, Patna.

Records of a number of ionospheric stations in north and south latitudes have been analysed to study the global characteristics of the seasonal and latitudinal variations of the negative storms in the ionosphere.

Seasonal variations of the intensity of the negative storms show two maxima at the equinoxes in all the stations in north and south hemisphere, the maxima being sharper the higher the latitude. But for the frequency of occurrence, the negative storms as well as the total number of storms show two maxima at the equinoxes at high latitude stations, but for low latitude stations the maxima occurs in the local summer months. The latitudinal variation of the intensity shows a regular increase towards the poles in all the seasons.

3. Diurnal variation of the apparent Reflection Coefficient and total Absorption of radio Waves in the Ionosphere

S. S. BANERJEE, S. K. SHARMA and J. B. LAL, Banaras.

The study of the ionospheric absorption is important as it is one of the predominating factors for deciding the lowest usable high frequency (l.u.h.f.) for any two distant stations. Observations have, therefore, been recorded for the measurement of apparent reflection coefficient of the F_2 region in the ionosphere and the total absorption of radio waves reflected from the same region by using pulse technique at frequencies 5.5 mc/s and 6.0 mc/s which are quite above the critical frequency of the E-region. The diurnal variation of these quantities shows that the minimum reflection

coefficient does not occur exactly when the zenith distance of the sun is zero, but a little earlier. It has been further observed within the limits of frequencies used for observations, that the minimum reflection coefficient at higher frequency occurs a little earlier than that at lower frequency. Curves showing the relation between the total absorption and zenith distance of the sun in the daytime reveal that during the noon hours the ionosphere does not usually behave as a simple Chapman region. These anomalies have been explained as due to thermal expansion of the F_2 region of the ionosphere which are more marked in the daytime specially in the lower latitudes.

4. Simultaneous study of short time Variations of signal Strength due to oblique Incidence, C.W. and vertical Incidence pulse Transmissions reflected from the Ionosphere

B. RAMACHANDRA RAO and K. V. V. RAMANA, Waltair.

In the present investigation, the variation of field strength on both pulse and C.W. signals are compared every day over a period of about half-an-hour with a view to find the extent of correlation between them. Signal strength of short wave transmissions from Madras on 9.5 Mc/sec are recorded at Waltair continuously on an Easterline Angus Recorder between 1600 hrs and 1630 hrs. Simultaneously the variations in the amplitude of first hop reflections at vertical incidence from the ionosphere were photographically recorded using conventional pulse equipment radiating on the equivalent vertical incidence frequency of 3.15 Mc/sec. A plot of the mean amplitudes for the CW and pulse records revealed a distinct correspondence in the variations of these signals. From a statistical analysis of a number of observations taken during the period of May and June, it was found that the correlation coefficient between the two signals is significantly high being in the range of 0.41 to 0.61. The average value of the correlation coefficient is found to be nearly 0.5. These observations lead to the tentative conclusion that this significant correlation between the two records may be due to the variations in the ionisation in the D-layer. On a single day when sporadic E was active the correlation was found to be low.

5. A study of Atmospherics in the Long-Wave Region

M. W. CHIPLONKAR and V. N. ATHAVALA, Poona.

Frequencies of occurrence of atmospherics on four discrete wave-bands (85 kc/s, 125 kc/s, 175 kc/s & 455 kc/s) are being recorded at Poona in the University Department of Physics since June 1954. Four straight T. R. F. receivers have been used and the outputs of these are given to four different counters. Spot readings of the counters are visually noted over a period of three minutes at the end of every hour. The diurnal variations studied for the period (September 1954 to August 1955) show identical trends for all the bands viz. a sharp minimum around 0800 hours and a very broad maximum extending from about 2000 hours to about 0400 hours. These curves show that the minimum frequencies of occurrence diminish with increasing frequency of the bands studied. There is an annual variation for each of these bands showing a minimum during November, December & January and a maximum during May, June & July. This annual variation is true for all the hours of observation and for the four frequency bands studied.

6. Terrestrial Atmospherics

B. A. P. TANTRY, R. S. SRIVASTAVA and S. R. KHASTGIR, Banaras.

An automatic atmospherics recorder was constructed and used for the investigation of the wave forms of atmospherics. Raster arrangement was made to give four or five horizontal lines on the oscillographic screen. Suitable circuits were employed for obtaining complete, accurate and non-overlapping oscillograms. A video amplifier was also constructed for recording 'precursors'.

Nearly 5000 records taken during 1952-1955 have been analysed and the various waveforms are classified as follows:

- (i) Aperiodic or regular peaked type
- (ii) *Quasi*-periodic or damped oscillatory type
- (iii) Irregular high-frequency type
- (iv) Aperiodic or *quasi*-periodic followed by slow component
- (v) Aperiodic or *quasi*-periodic preceded by slow component
- (vi) Aperiodic or *quasi*-periodic preceded and followed by slow component
- (vii) Ionospheric reflection types:
 - (a) Peaked type repeaters
 - (b) *Pseudo*-damped oscillatory type
 - (c) *Quasi*-sinusoidal type
 - (d) Wavy border on slow component

Definite evidences have been obtained of the waveforms associated with the *a*, *b*, and *c*-parts of the field change during a lightning discharge. Interpretations have been given of the various types of observed waveforms. The time-interval of the 'repeater' pulses or that between successive crests on the wavy border has, in many cases, given the distance of the thunderstorm centre and the height of reflection from the ionosphere. Simultaneous records of direction-finding and of the wave forms have enabled location of thunderstorm centres.

7. Limitations of a Microwave Radar under different Weather Conditions

B. CHATTERJEE, Kharagpur.

The paper discusses in a simple manner the limitations of the useful maximum range of a microwave radar under different weather conditions. Calculations on limitations of the maximum range have been made under different climatic conditions and in presence of different rates of rainfall, with particular reference to the weather conditions present in India.

8. Microwave Dielectric Loss of Seedlac

S. S. SRIVASTAVA, New Delhi.

The dielectric constant and dielectric loss of seedlac has been studied over a wide range of frequencies from 10^6 to 10^{10} cps. Radio frequency bridges, cavity resonators and standing wave technique has been adopted for suitable ranges of frequencies. In 10-cm region, a silver plated E_{010} cavity resonator has been set up to measure the dielectric constant and loss, while in 3-cm region, SWR measurements have been carried out with precision. The $\tan \delta - \log f$ curve of the sample shows a very broad maximum. The broadened peak suggests a distribution of relaxation times around a central

maximum. This distribution has been worked out for this case; and the value of α which is a measure of the breadth of the distribution of relaxation time has been calculated. Technique adopted for the measurement of dielectric loss and values of $\tan\delta$ for seedlac samples are reported in this paper.

VI. GENERAL PHYSICS, METEOROLOGY AND GEOPHYSICS

1. Ultrasonic Velocities in Liquids by an improved Liquid Film Method

B. RAMACHANDRA RAO and D. RANGARAO, Waltair.

Ultrasonic velocities in some organic liquids are determined by using a modified liquid film method employing a balanced bridge D.C. amplifier circuit with two identical thermocouples in the grid circuits each of which is connected in series with the piezoelectric crystal and a compensating condenser which are connected in parallel across the output of an oscillator. An accurate measurement of the crystal current, as it approaches resonance, is achieved by adjusting the variable compensating condenser to have the same capacity as the crystal.

Using an X-cut quartz crystal of 1.5 Mc/sec. fundamental and a liquid film of thickness 3 mm, the fundamental frequency of the film and hence the velocity is determined by measuring the frequencies at which discrete and sharp maxima in the crystal current are observed due to the film being thrown into vibration at one of its several harmonics. Ultrasonic velocities for six organic liquids showed very good agreement with standard values. The method is simple, accurate, and particularly useful for liquids, available in small quantities.

2. New Methods for measuring Ultrasonic Velocities in Solids and Liquids

S. GOPALA MENON, Trivandrum.

Two methods for measuring ultrasonic velocities in solids and liquids using a Debye-Sears optical cell are described. In one method a spectrometer is used, the cell being mounted on the prism table, and the diffraction pattern is viewed through the telescope. One half of the sound beam entering the cell proceeds straight into the liquid while the other half passes at normal incidence through a right angled prism of the chosen solid kept immersed in the liquid. On turning the prism table, the diffraction pattern is seen clearly in two positions whose angular separation gives the deviation produced by the prism, from which the ratio of the ultrasonic velocities in the two media may be readily determined.

In the second method, a thin wedge of the solid is introduced vertically in the path of one half of the sound beam through the liquid and the diffraction pattern is photographed using a cylindrical lens. Each other diffracted image will have equidistant dark gaps and the diffraction pattern will be seen crossed by equidistant horizontal dark bands. The distance apart of these bands may be used to compare the velocities in the solid and liquid chosen.

3. Ratio of Ultrasonic Velocity in Liquids and Vapours

S. K. K. JATKAR and D. D. DESHPANDE, Poona.

Lagemann had shown that the ratio of ultrasonic velocity in liquid to that in its vapour is constant for all liquids except associated ones.

In the present paper, it has been shown that the ratio is 6 for normal liquids and three for associated liquids. Liquified gases behave as associated liquids. A further calculation shows that the ratio is identical with $\sqrt{\frac{C}{\gamma}}$ where C is the Molar heat capacity of liquid and γ is the ratio of sp. heats C_p/C_v , for the vapour of the same liquid. This forms an empirical method of calculating ultrasonic velocity in liquid of which the molar heat capacity is known, γ being calculated from spectroscopic data.

4. Persistence of Striation Grating of starch Suspensions in Liquids after stopping the Ultrasonic Waves

B. RAMACHANDRA RAO and C. KRISHNAMURTY, Waltair.

While working with suspensions of starch in water contained in an ultrasonic cell, it is observed that by the action of ultrasonic waves, particles of moderate size are driven to the nodes forming sharp striations visible to the naked eye, which persist for a few seconds after the stopping of the ultrasonic waves. Moreover the persistence time is found to depend on the grain size, wavelength and viscosity of the medium. A systematic investigation of the effect of size of the grains on the persistence time was made and it was found that the persistence time varies roughly in inverse relation with the square root of the average volume of the grains. The effect of the wavelength on the persistence time was studied by using four different quartz crystals taking care to see that power is same in all the cases. The persistence time is found to vary linearly with the root of the wavelength of sound in the liquid. The effect of viscosity on the persistence time in agar-agar sols is studied as it sets into a gel and it is observed that the persistence time increases very rapidly with time of setting leaving ultimately a permanent grating when the gel is formed.

5. Estimation of the Density of Dislocations in the grain Boundary Regions of Polycrystalline tin.

P. G. DEO and B. D. SHARMA, Lucknow.

Differential etching along grain boundaries was studied by subjecting polycrystalline white tin to cathodic sputtering. The experimental procedure adapted was similar to that reported earlier (Deo, *Proc. Ind. Sci. Cong.* 1955; *Phys. Sec. Abst.* 34). With a cathode-anode gap of 1.2 cm, the polished specimen of tin was sputtered in a flushing atmosphere of argon (pressure 0.1 mm) at a rectified applied potential of 500 volts.

The etched surface was examined microphotographically. Considering areas in the neighbourhood of junction of a triocrystal it was observed that the metal sputtered differentially in different grains. The grain boundaries among themselves were also found to show differential sputtering.

The results are explained on the basis of dislocation model of simple grain boundary. Relative (surface) energy tensions are calculated from the measurement of dihedral angles of the grain boundaries. The small angle of misfit for the grain boundary is evaluated from Aust and Chalmers' data for grain boundary energy vs small angle of misfit for white tin. From the knowledge of the angles of misfit and the lattice constant the densities of dislocations in different grain boundaries are found to be of the order of $10^{12}/\text{cm}^2$. This is characteristic of severely cold worked metal.

6. Electro-dynamic Shift in the 1S-level of Hydrogen

INDERJIT SINGH and F. C. AULUCK, Delhi.

The quantum electrodynamic shift in the Dirac nS -level of a hydrogen-like atom of charge number Z , is given by the relation

$$\Delta E(n,0) = \frac{8Z^4\alpha^3}{3\pi n^3} R_y \left[\ln \frac{\mu}{k_0(n,0)} - \ln 2 + \frac{5}{6} - \frac{1}{5} \right]$$

where μ is the rest-energy of the electron, α the Sommerfeld fine-structure constant. The geometric average of the excitation potential $k_0(n,0)$ for the Dirac level $(n, l=0)$, is defined by the identity,

$$\begin{aligned} \ln \frac{k_0(n,l)}{R_y} \sum_m |(n,0|p_x|m)|^2 (E_m - E_n) \\ = \sum_m |(n,l|p_x|m)|^2 (E_m - E_n) \ln \frac{E_m - E_n}{R_y} \end{aligned}$$

for any arbitrary momentum component p_x , of the bound electron. Knowing k_0 , the electrodynamic shift is easily calculated. The shift for the $n=2$ level has been evaluated numerically by Bethe, Brown and Stehen. We give here the result for the shift in the 1S-level of Hydrogen.

To get the value of the excitation potential we have to evaluate the function

$$F = \sum_m \nu^2 df(n,l;m) \ln \nu$$

where m goes over the discrete as well as the continuous spectrum. Here, the frequency

$$\nu = \frac{E_m - E_n}{R_y}$$

and the oscillator strength,

$$df(1S, m) = \frac{128}{3} \nu^{-4} d\nu \frac{\exp[-4m \operatorname{arccot} m]}{1 - \exp(-2\pi m)}$$

for the transition from the original 1S-level to an element $d\nu$ of the continuum.

Using these relations, we get for the excitation potential of the 1S-level,

$$k_0(1,0) = 19.27 R_y$$

This gives for the shift in the 1S-level,

$$\Delta E(1,0) = 8149.0 \text{ M.C./Sec.}$$

7. Statistical Mechanics of He^3 and He^4 Solutions

S. K. TRIKHA and V. S. NANDA, Delhi.

In order to account for their vapour pressure measurements on dilute solutions of He^3 in He^4 Taconis, Beenakker, Nier and Aldrich have suggested that *He³ dissolves only in the normal part of He⁴*. On the basis of this suggestion the statistical mechanics of these solutions has been developed by de Boer and Gorter. This suggestion, however, must be regarded with a due amount of reserve, especially because the predictions of de Boer and Gorter's theory are not in good agreement with the subsequent experimental results.

A statistical mechanical theory of He^3 - He^4 solutions is developed, in which we have assumed that (i) He^3 mixes with the whole of He^4 (normal as well as superfluid), (ii) the contribution to the entropy of mixing is only due to the normal part of He^4 and (iii) the solution of He^3 in He^4 is not an "Ideal Solution" even above the λ -temperature. It obeys laws of a "Strictly Regular Solution". Agreement between theory and experiment concerning the λ -temperature of the solution, molar specific heat of mixing and vapour pressures is found to be satisfactory. The increase of the velocity of second sound in solution can be accounted for on this theory under the condition that He^3 particles partake in the motion of the normal fluid.

8. Higher Approximations to Diffusion Coefficients and Determination of force Constants

S. C. SAXENA, Calcutta.

Recently we have reported the computed values of several Chapman and Cowling collision integrals for gases obeying the Lennard-Jones 12 : 6 model over an extensive range of temperatures. Making use of these collision integrals along with those reported by Hirschfelder, Bird and Spotz, the correction factor for the third approximation to the tracer diffusion has been calculated by utilising the expressions developed by Mason on the scheme adopted by Chapman and Cowling. The third approximation to the coefficient of inter-diffusion and the second approximation to the thermal diffusion ratio have also been calculated for the particular case of A-He mixture. The effect of these higher approximations on the determination of the force parameter from the temperature dependence of the transport coefficients has been critically examined. It has been shown that these higher approximations do not vitiate the method developed by Srivastava and Madan elsewhere for calculating the force constants from the thermal diffusion data for unlike molecules.

9. Force Constants for unlike Molecules on Exp-Six Model from thermal Diffusion

B. N. SRIVASTAVA and K. P. SRIVASTAVA, Calcutta.

The potential parameters for the unlike pairs of molecules Ne-A, Ne-Kr and A- N_2 have been determined for the Exp-Six model from the temperature dependence of thermal diffusion of these gas mixtures following the method developed earlier by Srivastava and Madan. The method of translations given by Mason and Rice was employed to determine the parameters α_{12} and ϵ_{12} by successive approximations, taking into account also the small temperature variation of the 'g' factor and utilising Kihara's first approximation formula. The parameter $(r_m)_{12}$ was found by substituting the appropriate values of α_{12} and ϵ_{12} in the theoretical expressions for binary viscosity, inter-diffusion or thermal diffusion and utilising the experimental data. The values of the unlike parameters α_{12} , ϵ_{12} and $(r_m)_{12}$ thus obtained were utilised to calculate the thermal diffusion factor at different temperatures, using Kihara's expression, and the results obtained were found to agree with the experimental data within the limits of experimental error, thereby confirming the values of the potential parameters. The results show that $(r_m)_{12}$ could be calculated from the absolute value of the thermal diffusion factor if Kihara's first approximation formula is utilised and correct values of α_{12} and ϵ_{12} substituted. The combination rules for unlike potential

parameters given by Mason and Rice have been found to be inadequate and simpler combination rules have been suggested.

10. Influence of Magnetic Field and Electric Current on the Resistance of Metal Films

K. P. NANDY, Kharagpur.

A thick silver film with an average thickness of the order of 264×10^{-8} cm. was deposited on a glass slide by evaporating metallic silver under high vacuum (Pressure $\sim 10^{-3}$ mm. of Hg.). It was placed in a uniform magnetic field and its D.C. resistance was measured by potentiometric method. The resistance was found to be a function of both the strength of the magnetic field normal to the film surface and the strength of the current passing through the film. The resistance, at particular values of magnetic field and current, first decreases, attains a minimum and then increases with the increase of either of the parameters.

11. The generation of Electric charge by disruption of Raindrops

P. K. DAS and S. BANERJI, Gauhati.

Dr. Seville Chapman, in a recent paper, estimated the charging current due to disruption of falling raindrops. His values showed that this mechanism was capable of generating a lighting flash carrying 25 coulombs every 10 seconds, but the computations were based on a number of simplifying assumptions. It was assumed, for example, that all drops in the cloud were of equal size, and, that the drops could be treated as rigid spheres akin to molecules in the kinetic theory of gases. In this paper, an attempt has been made to assume a given drop-size spectrum, and then compute the charging current. The values obtained are one order less than Dr. Chapman's values.

12. (a) Magnetic Dipole excited by Transient Current over a Homogeneous Earth

BIMAL KRISHNA BHATTACHARYYA, Kharagpur.

Formulae of the electric and magnetic fields above a homogeneous earth have been determined for a magnetic dipole source excited by transient current. A magnetic dipole source has been assumed to carry currents of ramp-function and sawtooth types. These types of pulses are often used in electrical method of prospecting known as 'Eltran prospecting'. The object of this paper is to determine the theoretical response curves of transient pulses so that the interpretation of geophysical field data may be made possible.

Response curves of some useful curves have been plotted. The response for a step function input current has also been included to demonstrate the change of the shape of electric and magnetic fields above the surface of the earth as the steepness of the exciting pulse-fronts decreases.

12. (b) Transient Electromagnetic Propagation inside a Conducting Medium

BIMAL KRISHNA BHATTACHARYYA, Kharagpur.

Transient electric and magnetic fields have been calculated for ramp-function and sawtooth current sources immersed in a conducting medium. An electric dipole

source has been assumed. In the case of ramp-function input, the non-vanishing components of the electric and magnetic field intensities exhibit time-gradients varying with the change in steepness of the exciting pulse-fronts. The magnitudes of the overshoots in the case of $E\theta(t)$ begin to decrease as the ramp-function pulse takes a longer time to flatten off. Sharp rise-time of the energising pulse may be used if fast oscilloscopes are available to study critically the wave-fronts of the field intensities.

In the case of sawtooth pulse, $E\theta(t)$ has a negative overshoot the magnitudes of which become greater as the rise-time increases. It may be concluded from this study that an impulse function will not be propagated in a conducting medium. So for the work of geophysical exploration, sawtooth pulses having large values of rise-time should be used if one wishes to obtain appreciable magnitude of the electric and magnetic field intensities. A pulse of sharp rise-time cannot give rise to field intensities which can be easily measured. In such a case, it will be extremely difficult to detect the small irregularities of the field intensities at distant points.

13. Growth of Ionic Crystals

N. S. PANDYA and G. K. TRIVEDI,

(1) *Electrolytic Crystal formation* : Koichi Hirano (1954) has reported the crystal formation by electrolysis in the case of sodium nitrate in which he observed that the crystals were formed only on the cathode. This suggested the idea of growing crystals by a method suitable only for ionic crystals and to study the mode of crystal growth.

An electric current was passed at about 27°C. through a supersaturated solution of copper sulphate with a current density of 1.5×10^{-4} amp./cm.² and P.D. between the plates 0.1 V/cm. for 17 hours and it was observed that the crystals of copper sulphate were formed at the cathode.

The crystals showed interesting surface features. In most cases the surfaces of crystals showed the well-known mode of growth similar to the spiral mechanism as suggested by Frank and others.

(2) *Crystal Growth under strong magnetic fields* : To extend the work on the growth of ionic crystals the same copper sulphate solution was kept between the pole-pieces of an electromagnet having the field strength of 7000 Gauss. Rhombic crystals were formed in 3 to 4 hours at the temp. of 27°C. They were all symmetrically situated with respect to the direction of the magnetic field, the longer diagonals of the rhomb were all parallel to the direction of the field.

Further work in detail on the surface structure of ionic crystals grown by these different methods is in progress.

14. The boundary Electron Density of Diatomic Homonuclear Molecules in the Thomas-Fermi Model corrected for Exchange and Correlation Effects

J. V. BONET, Bombay.

An expression for the total energy of the Thomas-Fermi model of a diatomic homonuclear molecule, with additional exchange and correlation terms, is written in prolate spheroidal coordinates. It is then simplified by making use of the axial symmetry properties of the molecule and is shown to be a function of one coordinate only. Then, the total energy expression is minimized with respect to this coordinate. After considerable algebraic manipulation, and assuming that the total molecular charge is

bounded at a finite distance from the nuclei by a prolate spheroidal surface over which the electron density is constant, it is shown that the boundary electron density for all diatomic homonuclear molecules is equal to $0.003074/a_0^3$ (where a_0 is the radius of the first Bohr orbit for H), exactly the same value as the boundary electron density for atoms in the Thomas-Fermi model corrected for exchange and correlation effects.

15. The Charge and Discharge of a non-linear Condenser through a linear Lossless Inductance

ASOKENDU MOZUMDER, Kharagpur.

If a condenser is made with a semi-conductor as a di-electric and if *at least* one of the electrodes is blocking, then the resultant capacitance becomes voltage dependent, the nature of which has been shown by Macdonald to be of the form $C = C_0 \frac{\sinh \alpha V}{\alpha V}$ where 'C' is the capacity for a voltage 'V', 'C₀' is capacity for vanishingly small voltage and $\alpha = \frac{e}{2kT}$ or $\frac{e}{4kT}$ according as one or both the electrodes block. e =electronic charge, k =Boltzmann constant, T =absolute temperature. Macdonald and Brachman have found out the charge (from D.C.) and discharge characteristics of such a condenser through a linear resistance and have shown that the results are qualitatively similar to that for an exponential condenser for which $C = C_0 e^{\alpha V}$. In the present contribution, the charge and discharge of such a condenser through a linear non-dissipative inductance have been studied and compared with the case of an exponential condenser. It has been shown that the voltage and current will be periodic in time, with an error function waveform. The primitive of the differential circuit equation has been written in the form

$$t = \sqrt{\frac{LC_0}{2}} \int_0^V \cosh \alpha V \left[(\cosh \alpha V - 1) + \alpha(V_0 - V) \sinh \alpha V \right]^{-1/2} d(\alpha V)$$

where L =series inductance and V_0 =D.C. voltage applied. From this equation, expressions have been derived for periodic time and maximum condenser voltage.

16. Variability with Ageing, Rest and 'Head treatment' of positive and negative Joshi Effect in Mercury Vapour

B. B. PRASAD and V. SANKARA SUBRAMANIAN, Banaras.

That the *positive* Joshi effect occurs normally over a narrow potential range near, but slightly less than V_m and reverts to (more common) $-\Delta i$ in electro-negative and semi-metallic vapours, has been indicated by Joshi. (*Proc. Ind. Sci. Cong.*, 1947, Phys. Sec. Abst. 25). The conditions for the production of this $+\Delta i$ and its variability, with the chief electrical parameters, were comparatively less understood. (Prasad, B. B., *Journ. Sci. Research*, B.H.U. 1952-1953, 3, 7). It was of interest, therefore, to study in some details the extent of the potential range, productive of $+\Delta i$, in respect of particularly such factors as have been found to enhance and stabilize $-\Delta i$. It is now found that ageing under electrical discharge at a constant potential,

KV and or 'heat treatment' for few hours decreases $+\Delta i$. In mercury vapour this decrease is quite significant even upto the extent of complete eradication. Allow of a rest period helps to restore $+\Delta i$ partially; this restoration is more complete in longer rest periods. Thus e.g., $+\Delta i$ enhances from almost negligible magnitude to more than 1000% after a rest of two months. Further, the transition potential is found *inter alia* to depend largely on the factors mentioned above. The influence of applied potential is to decrease $+\Delta i$ numerically; and at sufficiently large KV. enough to break down the gas as dielectric, it almost vanishes. An explanation based on the (partially) reversible 'boundary layer' formation under electric discharge, has been developed.

17. Magnetograms during a severe thunderstorm at Alibagh

S. L. MALURKAR, A. S. CHAUBAL and D. K. DESHMUKH.
(Colaba and Alibag Observatories).

During a severe thunderstorm, there is a considerable fluctuation in the potential gradient at various levels from the ground. In view of the large earth air currents involved, it is sometimes considered that the magnetic field would also undergo fluctuations and would be shown on magnetograms. At Alibag magnetic observatory, two independent sets of magnetographs are in operation for the last several years. The Watson magnetographs are placed on pillars which go right deep into the ground and are kept aloof by guard rings from a working floor which forms part of a double-walled, double-roofed and double floored insulated cubicle. The La Cour Magnetographs are placed on pillars erected on the working floor several feet above the ground. The magnification and sensitivity of the horizontal and vertical Force magnetographs of both makes are of the same order while the La Cour declinograph is more sensitive than that of Watson.

On 2nd June, 1955 a thunderstorm with loud and persistent thunderclaps passed over the observatory. The period of thunderstorm was 1530-1900 hrs. I.S.T. The La Cour horizontal magnetogram showed a large number of oscillations with displacements amounting to 30γ . The La Cour D also showed considerable disturbances as had been previously observed by Ramanathan. The La Cour V was affected only slightly. However, the Watson magnetographs appear unaffected.

It would be difficult to assign the oscillations of La Cour magnetographs to changes in the magnetic field, which would have been reproduced in those of Watson.

SECTION OF CHEMISTRY

President :—DR. S. H. ZAHEER, M.A., Dr. Phil. Nat.

Abstracts

ANALYTICAL CHEMISTRY

1. Estimation of Isonicotinic Acid.

BIRESWAR BANERJEE, Calcutta.

A new method for the estimation of isonicotinic acid, by precipitation as copper isonicotinate, $\text{Cu}(\text{C}_6\text{H}_4\text{O}_2\text{N})_2 + 4\text{H}_2\text{O}$, is described. The most suitable pH region for the complete precipitation of copper isonicotinate was found to lie between 5.1 to 5.2, and the effect of volume and the precipitant is negligible. A 1% copper acetate solution was used for the precipitation. The precipitate was washed with cold water till free from copper, and then with alcohol; it was afterwards dried at 120°C for 3 hours and weighed as anhydrous copper isonicotinate. 1 gram of this anhydrous compound is equivalent to 0.8 gram of isonicotinic acid.

1A. Rauwolfia Alkaloids ; Some Observations on the Analytical Approach.

R. P. BANERJEE and M. L. CHATTERJEE, Calcutta.

Study of the absorption, distribution in tissues and excretion of hypotensive Rauwolfia alkaloids calls for the use of isolated pure components amenable to sensitive and specific analytical determination. Significance of the fluorescence of extracts of *Rauwolfia serpentina* Benth. vis-a-vis its prospective application for estimation of alkaloid in microquantities in biological material has been investigated using the technique of countercurrent distribution.

The fluorescence is composite in nature and resolves into at least 4 fractions on appropriate treatment. Three of these cannot be associated with any of the principal alkaloids existing in solution and belong to materials comprising a very small fraction of the alkaloid mass. Another fluorescent fraction belongs authentically to a hypotensive alkaloid isolated from the system.

Fluorometric methods are therefore not suitable for estimation of alkaloid material when a preparation containing several alkaloids is employed; even when a single component is in question the fluorescence should be in advance proved to be characteristic of the alkaloid molecule itself. The findings described emphasise the need of caution in employing ultraviolet irradiation followed by observance of fluorescence on paper chromatograms for the purpose of locating and assigning R_f values to individual alkaloids.

2. Gravimetric Estimation of Silver by S-Methyl Thiourea Sulphate.

SATYENDRA NATH BANERJEE and SUSHIL KUMAR SIDDHANTA,
Kharagpur.

Siddhanta and Kundu (*Science & Culture*, **19**, 506, 1954) have used S-methyl thiourea sulphate as a gravimetric reagent for copper and nickel. In the present paper this reagent has been successfully used for the gravimetric estimation of

silver in an ammonical medium taking an advantage of the formation of the highly insoluble, stable, granular precipitate of silver methyl mercaptide. An effective separation of silver from zinc has also been made in a strongly ammonical solution containing some ammonium nitrate. In the estimation of silver as silver chloride—the universally employed method—a correction is necessary due to the solubility of silver chloride in water; silver methyl mercaptide being highly insoluble no such correction is necessary in the present method.

3. Colorimetric Estimation of Vanadium with Salicylhydroxamic Acid.

AJIT SANKAR BHADURI, Calcutta.

The present paper describes the use of salicylhydroxamic acid for the colorimetric estimation of vanadium by means of solvent extraction of the colored product with ethyl acetate followed by visual comparison of color under comparable conditions.

4. Use of S-di-P-Tolyl Thiovioluric Acid as a Reagent for Gravimetric Estimation of Metals.

P. N. BHARGAVA and B. SATYANARAYANA, Banaras.

S-di-P-tolyl thiobarbituric acid was prepared by condensing S-di-P-tolyl thiourea with malonic acid in the presence of acetyl chloride and anhydrous sodium acetate and its isonitroso compound was used as a gravimetric reagent for the estimation of metals.

5. Estimation of Free Acid in Uranyl Nitrate by Ion Exchange.

D. V. BHATNAGAR, Bombay.

To determine the free acid in an aqueous solution of uranyl nitrate, the test solution was passed through a column of the cation exchanger, Amberlite IR-120(H), and after washing with water the effluent containing the free acid, present in the test solution, together with the acid liberated from the resin bed by exchange of the uranyl ions for the hydrogen ions of the resin, was titrated against standard alkali; a sensitive pH meter was used to detect the end point. The free acid was found by deducting from the total acid the acid equivalent to the uranyl ions in the influent. For this purpose uranium was determined accurately in an aliquot of the sample solution. The entire estimation takes about two hours.

6. A note on the separation of metals of the first group by paper chromatography. I.

A. C. CHATTERJEE and HARI BHAGWAN, Lucknow.

In this work use of strips of Whatman No. 1 filter paper impregnated with 10% potassium iodide has been made to detect silver, lead and mercurous when present alone or in mixtures. The experimental results indicate that as the concentration of potassium iodide is increased, the separation effected is better, the spreading of the zones of the separate iodides is decreased and less diffused with the result that the cations are easily identifiable. When papers are impregnated with 10% potassium iodide mixed with a little silicic acid, starch, agar-agar and gelatine, the spreading of the zones is further decreased resulting in the intensification of colours thus making the tests more reliable and sensitive. Agar-agar

and gelatine give the best results. The work is being extended to other groups using suitable impregnating substances containing appropriate protective colloids as fixary agent.

7. Chromatography with impregnated filter-papers.

A. C. CHATTERJI and HARI BHAGWAN, Lucknow.

The work reported in the previous paper has been extended. The effect of the following factors on 'S', spreading factor, defined as the ratio between the final and original band width, and the classical Rf values has been determined : (a) Width of the strip; (b) length of strip, unimpregnated; (c) time of irrigation; (d) content of water in ethyl alcohol, used as the solvent; (e) concentration of the precipitating agent in the solution for impregnating the papers (without colloid); (f) 'e' with fixed quantity of colloid; (g) concentration of the solution used for spotting the paper, and (h) concentration of the colloid with fixed quantity of the precipitating agent. Finally 'Rf' and 's' values of the cations have been determined by using different protective colloids.

It has been observed that by varying Rf 'e', 'f', 'g' the Rf and S values of the cations can be controlled as desired. The technique is simple and may be useful in qualitative as well as quantitative analysis and may give a clue to the relationship between chromatographic separations and the formation of rhythmic structures.

8. Lorentz-Lorenz expression as a new analytical constant for Fats and Oils : Part I, Ghee.

A. C. CHATTERJI and UMESH CHANDRA, Lucknow.

In order to establish a standard range of variation for the 'Molecular Refraction' of pure samples of the butter-fat (ghee), the value has been determined on 101 samples collected over 12 months from various places in U.P. 265 samples of ghee were also obtained from market—butter, foreign and from inland and local dairies. Though labelled as genuine, purity of these samples was tested by analysing them by known methods. As the age and the source of the samples were unknown, fresh cream from cow and buffalo milk, from which ghee was prepared, were also obtained from two dairy farms. For a critical study of the constants for the ghee of a particular buffalo, the 'Murrah' breed was chosen and ghee samples for 12 months were analysed. While collecting samples, it was borne in mind that the variations due to diet, seasonal changes, pasture and indoor feeding, age, period of lactation and idiosyncrasy of the animal must come into account.

It was found that the law of additivity was strictly followed by ghee when mixed in varying percentages with most common adulterants in the Indian market.

It was also shown that adulterants like hydrogenated sesame, coconut, safflower and mahwa oils could be detected upto 3.0%, 3.0%, 0.1%, 3.0%, and 3.0% respectively. The significance of the present method will be realised when it is remembered that the known methods sometimes fail to detect the adulteration upto 40.0%.

9. Lorentz-Lorenz expression as a new analytical constant for Fats and Oils : Part II, Mustard Oil.

A. C. CHATTERJI and UMESH CHANDRA, Lucknow.

A hundred samples of mustard oil were collected periodically in U.P. so that a standard could be assigned for the 'Molecular Refraction' of genuine specimens of the oil. Though labelled as genuine, the purity of the oils was ascertained by

analysis. Since the age of the samples was not known and the sensitivity of the analytical methods could not be relied upon, fresh samples of the oils were obtained by ether extraction and by expelling all the available varieties of the seed, and the constants were determined.

Various mixtures of genuine samples of the oil with the adulterants frequently employed in the market were prepared. It was found that the law of additivity was strictly followed by these mixtures. The method was found to be sensitive enough to detect the adulteration of argemone, sesame, groundnut, safflower and linseed oils upto 1.5%, 2.0%, 2.5%, 4.0% and 5.0% respectively as against the known methods which fail to check the adulteration upto 30.0% invariably.

10. A comparative study of the methods for determining percentage of Titanium dioxide in pigments.

S. M. DAS GUPTA, Delhi.

A comparative study of the various methods for determining percentage of titanium dioxide in pigments has been made. There are three methods by which titanium dioxide is usually determined, viz. Modified Jones Reductor Method, Liquid Amalgam Method, and Aluminium Reduction Method. From the analytical data so far obtained the aluminium reduction method appears to be suitable both for routine and occasional analyses.

11. Assay and identification of reserpine in Rauwolfia tablets.

S. C. DATTA, Calcutta.

Identification of reserpine and its assay has become a major problem to-day in U.S.A. as various products containing reserpine are sold in the market. The method used in the Food and Drug Administration, Washington D.C. consists of an extraction procedure and colorimetric determination of absorbences of the sample and standard relative to the blank at 532 m μ with a Beckman DU quartz spectrophotometer with matched 1 cm. quartz cells. The measurements are repeated at 5 minute intervals until the maximum intensities are attained which usually takes about 40 minutes.

A modified procedure for the assay and the technique of continuous ascending chromatography for its quick identification is described in this paper.

12. A D.C. arc method for the spectrographic determination of Hafnium in Zirconium.

R. K. DHUMWAD and M. D. KARKHANAVALA, Bombay.

A spectrographic method is presented for the quantitative determination of hafnium in zirconium in the range 0.2% to 5% HfO₂. The sample in the form of a fine powder is burnt in a D.C. arc at 15 amp. 220V., and the spectrum photographed with a large quartz spectrograph. The hafnia concentration is determined from the ratio of the intensities of the spectral lines HfII 2861.696 Å to ZrII 2856.065 Å. A standard deviation of $\pm 4\%$ has been obtained by this method for samples essentially free from other impurities, especially Fe, Mg, and Na.

13. A Quick Electrophoretic Separation Applied to Charged Particles in Solution and in Suspension.

J. DUTTA and A. SEN, Calcutta.

Kolin's method of separation of the constituents of a mixture which, in an electric field migrate and condense at the interface of two layers of liquids of

widely different electrical conductivity and further separate out into a band of layers corresponding to each component, has been extended to the separation of certain dyes, inorganic ions and cells of microorganisms.

The lower half of a U-tube is filled with an acedie buffer solution nearly saturated with sucrose and the mixture to be separated is mixed with glycerol and added as a thin layer on the surface of the dense sugar buffer mixture in one of the arms. The two arms are then filled with buffer solutions of acid and alkaline pH and potential difference is applied across the whole length of the U-tube. The constituents separate into thin layers within a short time.

Mixtures of (a) methylene blue and bromocresol green, (b) methylene blue and methyl red, (c) methylene blue, methyl red and bromophenol blue are resolved with Michaelis' Veromal buffer of pH 4.66 and 7.66 with 110 volts potential difference and 15 mA currents 10 minutes are enough for separation. A mixture of fluorescein and eosin as also a mixture of Cu and Co as their hydroxides in suspension separated similarly with 10% KCl within 20 minutes. The technique has also been applied to the separation of microorganisms in a mixed culture. Thus the alga *Chlorellapyrenoidosa* was separated from *Nostoeumscerum* in veronal buffer within 20 minutes using 400 volts.

It is suggested that this technique can be profitably utilised in various analytical problems.

14. Diallyl-dithiocarbamido-hydrazine as an analytical reagent Part I—Determination of Copper, Nickel, Zinc and Lead and separations of their binary mixtures.

N. K. DUTT and K. P. SEN SARMA, Calcutta.

The reagent in its enolic form forms definite complexes with bivalent metals like copper, nickel, zinc and lead which are precipitated quantitatively from their solutions under controlled pH values. Copper is precipitated quantitatively between pH 2.5 to 3.5, lead between 5 to 6, nickel between 8 to 9 and zinc between 7.5 and 8.6. The determination of copper, nickel, zinc and lead in binary mixtures Cu-Ni, Cu-Zn and Cu-Pb can also be done using the reagent.

15. Diallyldithio-carbamidohydrazine as an analytical reagent Part—II. Determination of copper, zinc and nickel in presence of iron and uranium.

N. K. DUTT and K. P. SEN SARMA, Calcutta.

It is shown that copper, zinc and nickel can be quantitatively precipitated even in presence of iron and uranium. Commercial binary alloys like brass and monel metal contain iron as an impurity to the extent of about 2-3%. The method is well suited for gravimetric analysis of such commercial alloys since the tolerable limits of iron are quite above those present in such alloys.

16. Colorimetric Determination of Pteroyl glutamic acid (Folic acid) in presence of Iron Salts.

S. K. GANGULY, Calcutta.

The colour reaction based on the method of Bratton and Marshall in the determination of Pteroyl glutamic acid is affected by iron salts. Estimation of Pteroyl glutamic acid in presence of iron salts like ferrous sulphate, ferric ammonium citrate and ferrous gluconate could be done after removal of iron from solution with H_2S in presence of ammonia and the excess of H_2S by evaporation under reduced pressure.

The limits of concentration of the iron salts where interference in the colour reaction was practically negligible, were 4 mgm., 7.2 mgm. and 6 mgm. in 100 c.c. respectively for ferrous gluconate, ferric ammonium citrate and ferrous sulphate. Higher quantities of the respective iron salts required the removal of iron in the Colorimetric estimation.

Determination of Pteroyl glutamic acid in liver extract and in solution of other B-vitamins with added amounts of each of the above iron salts (20 mgm. in 100 c.c.) could be effectively done after the removal of iron.

17. Spectrophotometric Determination of Cobalamines in Proteolysed liver.

S. K. GANGULY, Calcutta.

In the estimation of cyanocobalamine in proteolysed liver by the method of Rudkin and Taylor, based on the difference in optical density of vitamin B₁₂ and its dicyanide complex much interference was encountered in the spectrophotometric determination. The colour interference could be removed by treatment with Sodium bisulphite. In the estimation of vitamin B₁₂ however, in purified liver extract (10 µg/c.c.) the interference was negligible, and required no such treatment. The above method gave higher values for cyanocobalamine than the method of Boxer and Rickards based on the release of cyanide from vitamin B₁₂ on illumination. The cobalamines in proteolysed liver were then converted to cyano cobalamine by KCN and the resulting cyanocobalamine was estimated by the method of Boxer and Richards. The estimated value of cyanocobalamine then agreed fairly well with the value obtained by the method of Rudkin and Taylor.

Thus, cyanocobalamine as estimated by Rudkin and Taylor's method in proteolysed liver represented the total cobalamines resulting from the conversion of the homologues to cyanocobalamine and the dicyanide complex in presence of excess of cyanide. The total cobalamines in proteolysed liver of cow, goat and sheep have been estimated and the values obtained by the two methods have been compared.

18. Estimation of silver by benzimidazole.

S. P. GHOSH and H. M. GHOSE, Patna.

A new method for the estimation of silver by benzimidazole has been established. Silver is precipitated with an aqueous solution of benzimidazole as Ag. C₇N₂H₅ at pH 10. The precipitate is dried at 120° and weighed as such. The compound contains 47.97% silver. Silver can be quantitatively separated from thallium (I) by this method.

19. Microestimation of Iodides.

B. P. GYANI, Patna.

Determination of small quantities of potassium iodide (1000 to 25 micrograms per 100 ml.) by titration with KIO₃ in presence of hydrochloric acid and carbon tetrachloride (indicator) has been studied. In absence of interfering agents, an accuracy of 2% is easily attained if the mixtures contain 100 micrograms KI per 100 ml. Ferric ions appear to be indifferent but Ca++ ions produce about 10% higher values. The error is large at lower concentrations and may be 20% when only 20 micrograms of iodide are present.

20. Estimation of tannin-like constituents in coffee.

J. R. IYENGAR, C. P. NATARAJAN and D. S. BHATIA, Mysore.

In our earlier communication, it was reported that the 'lead acetate' values obtained by using lead acetate as a clarifier in the determination of tannins by A.O.A.C. method may be taken to include the major tannin-like constituents in coffee. In our present studies, comparative values of chlorogenic acid in coffee were obtained by two methods namely, U.V. absorption and the 'lead acetate' methods. It has been shown that the values for chlorogenic acid in green and roasted coffee as obtained by these methods are in close agreement, showing thereby, that the 'lead acetate' method may be used as the analytical procedure where U.V. spectrophotometer is not available.

21. Separation of Phenols by the help of Ion-Exchange Resins.

N. S. KAPUR and E. R. COLE, Sydney.

Quantitative separation of phenols has been attempted by several workers. But in all cases the recovery of the original material was impossible as the separation was not of the pure phenols but of the derivatives of the phenols. An attempt has been made to separate the phenols by the use of strongly basic resins. Some useful results have been obtained.

22. Separation of Phenols by Paper Ionophoresis.

N. S. KAPUR and E. R. COLE, Sydney.

Phenols, especially ortho-di-hydric, form complexes with boric acid. This fact is utilized for the separation and characterisation of small quantities of phenols by the help of ionophoresis on borax impregnated paper. Useful results have been obtained and a simple means of characterising the phenols is presented.

23. A reagent for colorimetric estimation of Sugars.

G. P. MATHUR and S. MUKHERJEE, Kanpur.

A procedure for colorimetric estimation of sucrose, glucose, fructose and sorbose has been standardised. 1 ml. of the sugar solution and 5 ml. of 2% (W/V) Thymol in glacial acetic acid-conc-hydrochloric acid (4 : 1) mixture, were placed in a test tube and heated in a boiling water bath. (The heating time necessary for maximum colour production varied with the nature of the sugar and was determined). After cooling to room temperature, the pink colour produced was measured in a Klett Summerson photoelectric colorimeter using a blue filter (No. 42, transmission 400-465 $m\mu$). The relationship between concentration and absorption was linear within a range of 0.1 mg. to 1.5 mg. per ml. of sugar solution.

24. Studies on the detection and Chromatographic Separation of Digoxin, Gitoxin and Digitoxin.

B. K. MOZA, Calcutta.

For the spot detection of digoxin, gitoxin and digitoxin individually, on paper, a modified Keller-Kiliani reagent was found to give deep blue spot for each, the fluorescence of which under ultraviolet light was found to be apple green for

digoxin, sky blue for gitoxin and blackish blue for digitoxin. But after development with various solvent mixtures, the digitoxin spot on paper chromatograms was not found to emit a distinct fluorescence as was the case with other two, and appeared as a blackish spot only.

Among many solvent mixtures tried, the aqueous phase of the mixture of ethyl acetate, methyl alcohol and water in the proportion of 3:1:3 was found to give best results. With an equilibration time of two hours and development time of four hours at $30 \pm 1^\circ\text{C}$ the following R_f (f) and R_f (c) respectively were obtained for digoxin 0.96, 0.91, gitoxin, 0.0, 0.0, and digitoxin 0.97, 0.82.

25. Separation of Uranium from Vanadium by Ion Exchange : with Special Reference to the Determination of Small Amounts of Uranium.

T. K. S. MURTHY, Bombay.

An ion exchange method for the separation of uranium from Vanadium has been described. From a test solution containing excess sodium carbonate uranium was strongly adsorbed, as the complex uranyltricarboxylate ion, by passing through a bed of anion exchanger, Amberlite IRA-400 in the chloride form. Vanadium as Vanadate (VO_3^{1-}) was only moderately adsorbed and could be eluted quantitatively using 10% sodium carbonate solution leaving all the uranium in the column. Uranium was then eluted with 5% sodium chloride and estimated by a suitable method.

26. Buffered Paper Chromatography of Sugars and Related Substances : Part II.

S. N. PARIKH and A. N. GODBOLE, Baroda.

Glycerol, sorbitol, dulcitol, mannitol, *l*-arabinose, rhamnose, glucose, fructose, *l*-sorbose, *d*-xylose, galactose, lactose and raffinose in 1% aqueous solutions were investigated chromatographically with phenol-water (4:1) solvent and Whatman No. 1 filter paper buffered with sodium acetate-hydrochloric acid buffers, boric acid-KCl-NaOH buffers and universal buffers and also with ethyl acetate-pyridine-water (2:1:2) solvent and paper buffered with borax-succinic acid buffers and phosphate buffers. The effect of the salts has also been investigated by using paper impregnated with the salt solutions and also by spotting the salts with the substances on plain paper. The effect of the various factors on the R_f values of these substances on buffered paper is discussed.

27. Use of Thiazolidones and 5-amino-thiazolidones as Analytical Reagents for Copper and Silver.

BIRENDRA KUMAR PATNAIK and M. K. ROUT, Cuttack.

In the present investigation, 2-p-tolyl-imino-4-thiazolidone has been used for the estimation of copper and 5-amino-2-p-nitro-phenylimino-4-thiazolidone for estimation of silver. The former compound was prepared by reaction of p-tolylthiourea and mono-chloroacetic acid in presence of anhydrous sodium acetate and absolute alcohol while the latter was obtained by cleavage of the azo compound derived from 2-p-nitrophenylimino-4-thiazolidone.

28. Rhodanine N-Benzic and N-Salicylic Acids and their use in the estimation of Thorium

H. K. PUJARI and M. K. ROUT, Cuttack.

In the present investigation, Rhodanine-N-benzic and N-salicylic acids prepared by the interaction of potassium monochloroacetate with potassium dithio-

carbamates derived from anthranilic acid and p-amino salicylic acid have been used for the estimation of thorium. A probable structure has been proposed for the thorium complex obtained. Additional support in favour of the proposed structure has been provided by ignition of a definite weight of the complex to ThO_2 .

29. Conductometry in Leather Research : Part I Application to Syntans.

D. RAMASWAMY and Y. NAYUDAMMA, Madras.

Syntans are mainly polyphenolic aromatics or aromatic hydrocarbons condensed with an aldehyde. Since the syntan derives its solubility from sulphonic acid and its salt and its tanning action to the phenolic group, the determination of these groups is important. The usual methods of analysis of these groups along with the residual acid, if any, are elaborate, time-consuming and unreliable. The possible application of conductometry to the determinations of these groups is dealt with in this paper. The titration technique when applied to certain sulphonic acids and synthetic mixtures of these acids with sulphuric acid and phenol showed that quantitative results could be obtained. The conductometric titration procedure has been successfully applied to certain syntans. The results indicate that not only sulphuric acid, sulphonic acid and phenol could be simultaneously titrated differentially but also a general classification of the syntans is possible by this technique.

30. An acid-base indicator principle in the flowers of Rakta-Karabi (*Nerium odorum* Soland).

P. K. SANYAL and H. K. DAS, Calcutta.

An alcoholic extract of the dry flowers of *Rakta-Karabi* (*Nerium odorum* Soland) has a pink colour, which changes to green on addition of alkali; the colour reappears when acid is added. As the colour changes were not sharp, a chromatographic separation of the indicator principle was carried out using acidic Brockmann alumina column. Several acid base titrations were then performed with this indicator to evaluate its suitability. The pH at which *Karabi* indicator changed colour was found to vary between 5.4 and 5.7. This indicator should therefore give good results for titration of strong acid with moderately weak base.

31. Chemical and bacteriological analysis of drinking water of Darjeeling.

SATYA RANJAN SARKAR, Darjeeling.

Water in Darjeeling is supplied from the springs. It is stored in the Sanchal Lake about 7 miles from the town at an altitude of 7,500 ft. The results of chemical analysis are expressed in parts/100,000. The total solid of the spring on three days before, during and after monsoon are 9.1, 2.4, 1.42; pH is 7.2, 6.9, 6.7; Chloride 0.8, 0.4, 0.3; Total Hardness 1.4, 2.5, 3.8; Permanent Hardness 1.1, 1.2, 3.0; Temporary Hardness 0.3, 0.3, 0.8; Free and Saline Ammonia 0.022, 0.00768, 0.014; Albuminoid Ammonia 0.025, 0.0182, 0.022; Oxygen Absorption (4 hours) 0.42, 0.25, 0.143; Nitrate as Nitrogen 0.09, 0.053, 0.0553 respectively. The results of the lake water on the above dates are : Total Solid 10.2, 2.4, 1.0; pH 7.2, 7.3, 6.8; Albuminoid Ammonia 0.03, 0.0192, 0.0153; Oxygen Absorption 0.44, 0.15, 0.11; Chloride 0.8, 0.5, 0.4; Total Hardness 2.2, 1.4, 1.2; Permanent Hardness 1.9, 1.05, 1.2; Temporary Hardness 0.3, 0.35, 0.2; Free and Saline Ammonia 0.02, 0.0115, 0.0076; Nitrate as Nitrogen 0.09, 0.0498, 0.0568, respectively. The results of filtered water on the above dates are : Total Solid 8.5, 2.0, 1.2; pH 7.2, 6.9, 6.8; Chloride 0.7, 0.5, 0.3; Total Hardness 1.84, 1.5, 4.0; Permanent Hardness 1.54, 1.05, 3.2;

Temporary Hardness 0.3, 0.45, 0.8; Free and Saline Ammonia 0.009, 0.00384, 0.00672; Albuminoid Ammonia 0.018, 0.00661, 0.014; Oxygen Absorption 0.2, 0.16, 0.097; Nitrate as Nitrogen 0.08, 0.05, 0.055 respectively.

The bacteriological tests were also carried out to have a clear, scrutinising idea about the efficiency of filter bed (pressure type sand filter). The samples from the spring collected on the above three days show plate count 1800, 430, 220, and presumptive coliform count 180, 160, 160 respectively. Lake on the above dates shows count 10700, 1200, 1020, and P.C. count 180, 30, 50. So the spring and lake water show reasonable and gradual decreasing figures. Before 'alum' samples show coliform negative on all the three dates and count 210, 16, 6 which are quite satisfactory. After alum shows in general on the above three dates flocculation of bacteria. After filtration sample on the above three dates show count 72, 190, 75 and P.C. count 5, 8, 5. This is not highly satisfactory, the possible cause may be that the filter beds have become very old. After chlorination samples and also the taps from the town in all the three dates show negative P.C. count and P. count as 20, 30, 50 etc.

32. Triangular Chromatographic Studies.

K. C. SAXENA and M. SREENIVASAYA, Lucknow.

A study of the chromatographic pattern and the degree of resolution of a mixture of amino acids has been made employing Whatman No. 1 filter paper cut into the shape of an isosceles triangle whose vortex is surmounted by a rectangular piece. This extension offers not only the space for spotting or streaking the test solution but also provides the channel through which the solvent mixture is "piped". The rate of flow can be controlled either by altering the width of the rectangular appendage or by attaching one more pieces of the same size to it.

The chromatogram can be developed by any of the known unidimensional techniques—ascending, descending, horizontal or inclined. Our studies with known mixtures of amino acids and protein hydrolysates, have shown that surprisingly discreet separations of the individual components can be obtained, so that the amino acid bands can be cut, eluted and estimated in the usual way. The mechanism of this separation is discussed.

33. A Rapid Procedure of Separating RaD, RaE and RaF from Radon Needles.

HARI D. SHARMA, Bombay.

A rapid procedure for the separation of RaD, RaE and RaF from radon needle has been outlined. RaF has been extracted using tributyl phosphate in dibutyl ether from a 5N HCl solution and diethyl ammonium diethyl dithio carbamate in chloroform has been used for the extraction of RaE. The whole procedure can be carried out in fifteen minutes.

34. New Colour Reactions for distinguishing palmarosa and ginger grass oils.

L. M. SRIVASTAVA, Hyderabad-Dn.

Hyderabad State is an important producer of palmarosa and ginger-grass oils. During the course of work on the large scale rectification of inferior grade palmarosa oil, it became necessary to develop a rapid and easy method for distinguishing between palmarosa and ginger-grass oils and their mixtures. These oils are obtained from two morphologically indistinguishable varieties of *Cymbopogon Martini*. Since palmarosa oil is commercially more valuable than ginger-grass oil

because of its higher geraniol content, the former is usually adulterated with the latter. During the isolation of the oil the two varieties are often distilled together yielding a composite oil.

Of the many reagents tested (a) Phloroglucinol, (b) Vanillin, (c) Phosphomolybdic acid have been found to be the most suitable. The colour obtained in spot test and in solution, with various concentrations of the reagents is described. Any oil sample giving a positive test for both the oils with all the three reagents would indicate adulteration. Qualitatively the depth of the colour would indicate the extent of adulteration. Several samples of palmarosa oil and ginger-grass oil and mixtures of them were tested with the above reagents and the results obtained were satisfactory.

35. Use of alcoholic solutions in potentiometric estimation of chloride and its application to cane juices.

VISHNU, Kanpur.

The possibility of enhancing the precision of potentiometric titration of chloride, by adding rectified spirit to the mixture being titrated has been investigated. It is found that the inflection in presence of alcohol is much higher than in pure aqueous medium. Addition of alcohol is found to be particularly advantageous at low concentration (of the order of 0.02N Sodium chloride). Addition of acetic acid so as to lower the pH from 6.0 to 3.2 has no beneficial effect on the indication of end point. Presence of reducing sugars (5% glucose and 5% fructose in 0.02 N Sodium chloride) does not appreciably alter the end point but presence of formaldehyde even in traces in the rectified spirit upsets the titration.

The method is extended to determination of chloride in cane juices. Good indication of end point is obtained in mixed and clarified sugar cane juices. The method is more convenient than the usual chemical method for the chloride estimation as it does not require preliminary treatment such as oxidation of colouring matter etc. and is quick for routine determination.

36. Gravimetric estimation of lithium.

K. N. VISHWESHWARAI AH, C. C. PATEL and K. R. KRISHNASWAMI,

Bangalore.

A gravimetric method has been standardised for the estimation of lithium as lithium phosphate, taking advantage of the quantitative precipitation of lithium phosphate (Li_3PO_4) from a homogeneous aqueous alcoholic solution of lithium, by the addition of a reagent made by mixing β -diethyl amino ethyl alcohol and orthophosphoric acid. Other reagents tried were prepared separately by adding suitable proportion of orthophosphoric acid to β -dimethyl amino ethyl alcohol, diethanol amine, triethanol amine and 2-amino ethanol. These reagents gave lower values for lithium while the reagent prepared from β -diethyl amino ethyl alcohol gave quantitative results for lithium. By using the phosphate of this reagent, it is possible to estimate lithium in solution containing 5 to 100 mg. even in presence of varied amounts of sodium and potassium.

37. Spectrophotometric determination of palladium using 2-mercapto-benzimidazole.

J. XAVIER, Calcutta.

2-Mercapto-benzimidazole (o-phenylene thiourea) forms with acid solutions of bivalent palladium a crimson-red crystalline compound having indefinite composition. In very dilute solutions an orange-yellow colour is developed which has been

made the basis of estimating palladium spectrophotometrically in aqueous medium. The measurements of the colour absorbancy were made at $360\text{ m}\mu$ between pH values 1.0 to 2.60. 0.5 cc. of 1% alcoholic solution of the reagent was sufficient to develop the maximum colour when the palladium content did not exceed 0.25 mg. The colour intensity remained unchanged for more than 24 hours at temperatures $20-35^\circ\text{C}$. It was found to obey Beer's law and the sensitivity was 0.005γ Pd per cm^2 (Sandell) and 0.03γ Pd per cm^2 (practical). Au, Pt, Mo, V.W, Cu and Fe interfered. But the interference caused by iron could be eliminated by the addition of phosphoric acid.

PHYSICAL CHEMISTRY

38. Decomposition of ammonium nitrate in soil.

P. N. AWASTHI and A. K. BHATTACHARYA, Saugar.

The effect of the addition of pure ammonium nitrate to the Saugar soil was studied in presence of sunlight. It was found that the loss of nitrogen due to decomposition of ammonium nitrate was 42.04, 46.16 and 50.22% in two months, 52.24, 56.66 and 60.64% in four months, 58.49, 63.58 and 67.54% in six months and 63.95, 70.20 and 75.01% in eight months when 1, 3 and 5 g. of ammonium nitrate were added per lb. of the soil and exposed to sunlight. This loss has been explained from photo-chemical point of view in which ammonium nitrate forms unstable ammonium nitrite at the intermediate stage which decomposes with the evolution of nitrogen.

39. Tyndallometric study of the New Equation connecting the electrolyte concentration and time of coagulation.

AMAL K. BHATTACHARYA and ABANI K. BHATTACHARYA, Agra.

In the previous communications, the relation between the concentration, C of the electrolyte and the time of coagulation, t had been expressed by the New equation, $C = a + \frac{m \cdot 1/t}{n + 1/t}$ where a , m and n are the parametric constants. In order to verify the merit of the New equation further the time for the same stage of coagulation with different concentrations of the electrolyte have been determined from the Time-Tyndallogram and Time-Disperseodogram of Tezak and coworkers (J. Phy & Colloid Chem., 1951, 55, 1557) who studied the coagulation of silver halide sols in statu nascendi. The data on the time of coagulation at the same stage by adding different concentrations of the electrolyte in the foregoing tyndallometric studies were in agreement with the New equation. It was observed that when t was plotted against $1/C-a$, straight lines were obtained for each set of values according to the relation $\frac{1}{C-a} = \frac{n}{m}t + \frac{1}{m}$ which readily follows from the New equation $C = a + \frac{m \cdot 1/t}{n + 1/t}$

40. Molecular Rotation and Absolute Configuration—Part I: Sugars.

AJAY K. BOSE and BASANTA G. CHATTERJEE, Kharagpur.

Taking a clue from Boy's work we can state a rule of wide generality in the following form:

If the absolute configuration of a pair of epimeric compounds (containing one or more asymmetric carbon atoms) be represented by the projection formulae I

and II, the epimer I will be more dextrorotatory than II when L (large), M (medium), S (small), and T (tiny) are in the decreasing order of their steric bulk in the vicinity of the asymmetric carbon atom. When the asymmetric carbon atom is a member of a six-membered (or five-membered) ring system, the part of the ring on one side of the carbon atom constitutes L and the part on the other side, M; S may be part of another ring.

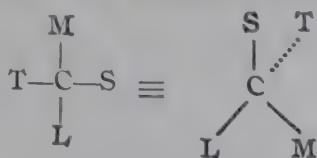


Fig. I

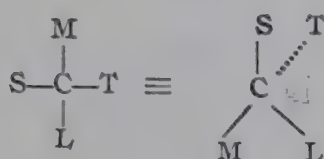


Fig. II

This rule covers Hudson's Isorotation Rule and Lactone Rule and also the modified Lactone Rule due to Klyne. D-Allo-furano-lactone, which is levorotatory, violates the Lactone Rule but not our rule.

Our rule has been applied successfully to hexose pyranosides epimeric at C, (cp. Hudson's Isorotation Rule), C₂, C₄, or C₅, to furanosides epimeric at C₄, to glycomethylo-pyranosides, to glycosans and other anhydro sugars, and to glycals and amino sugars.

41. Effect of Organic additives on the viscosity of the system : Water-sodium laurate and butanol-1.

A. N. BOSE and VIRENDRA K. DIXIT, Lucknow.

Solubility of benzoic acid and its substituted derivatives increases in aqueous solution of sodium laurate containing butanol-1. Increase in solubility at lower concentrations of alcohol is not only due to the presence of alcohol but is due to the presence of micelles as the solubility in 40% and 50% alcohol concentration is less than 10%, 20% and 30%. Solubility again increases when alcohol concentration is above 60%. This is due to the change in the phase i.e. system of water in butanol-1 is formed. From the viscosity determination, it has been shown that the insoluble acids are incorporated in the micelle. Increase in viscosity in presence of phenols is due to the hydration.

42. Effect of Oleic Acid and Sodium Hydroxide on the solubilization of butanol-1 and 3-methyl butanol-1 in aqueous solution of sodium oleate.

A. N. BOSE and K. N. MEHROTRA, Lucknow.

Solubilizing capacity of aqueous solution of acid soap and neutral soap for butanol-1 and 3-methyl butanol-1 has been determined. It has been observed that the amount of butanol-1 solubilized is the same in aqueous solution of 75% neutralised oleic acid and in completely neutralised oleic acid. But for 3-methyl butanol-1 neutral soap acts as a better solubilizer than the acid soap. This is due to the fact that the loci of solubilization of both free acid and the alcohol is same.

It has been concluded from the viscosity determination of these systems that two types of micelles are formed. In the first type alcohol is solubilized in water which exists when the alcohol concentration is below 60%. In the second type water is solubilized in alcohol when alcohol concentration is above 60%.

43. Reciprocal exchange relationship between Na^+ and H^+ ions in clays.

SAROJ KUMAR BOSE, Calcutta.

The exchange equilibrium in the (1) H-clay+NaOH, (2) H-clay+NaCl and (3) Na-clay+HCl systems has been studied from the measurement of cationic activities by means of clay membrane and glass electrodes. For this purpose, 1 to 1.5% suspensions of the H-clay were equilibrated with varying amounts of NaOH and NaCl. After 2 days the Na^+ ion and H^+ ion activities were measured by means of clay membrane and glass electrodes.

The inflexion point occurs in the NaOH titration curve in the neighbourhood of 80-85% neutralisation. Na^+ ion activity shows an initial sharp decrease followed by a flat portion and then an increase corresponding to the inflexion point.

The equilibrium of the system, $\text{H-clay} + \text{NaCl} \rightleftharpoons \text{Na-clay} + \text{HCl}$, has been studied by separately measuring Na^+ and H^+ ion activities of the left hand and right hand systems brought to equilibrium with varying quantities of the electrolytes. It has been observed that the I_H curve corresponding to the left hand side system runs flatter than that of the right hand side system. The same is true of the Na^+ ion activities. This shows the existence of hysteresis in the exchange equilibrium of the systems studied.

A reason for hysteresis may be found in the structural peculiarities of the clays. In that case similar studies with other cationic pairs, e.g. Ca-H, K-H, etc. using different clays are likely to be of interest.

44. Exchange of Hydrogen ions in H-resin for Cations in Colloidal clays in water-alcohol medium.

A. CHATTERJEE, Calcutta.

The exchange of K-, Ca- and Na-ions from the respective clays for the H-ions of H-resin was studied in presence of 30% and 50% alcohol at varying concentration of the clays and amount of the H-resin. The percentage exchange decreases much more sharply in presence of both the concentrations of alcohol used than in water alone. The dehydrating effect is more clearly illustrated by the study of Na-ion exchange from Na-clay, which even in presence of 30% alcohol retains its exchange characteristics shown in aqueous medium. With 50% concentration of alcohol the exchange behaviour of Na-clay is similar to that observed with K- and Ca-clays viz., a sharp fall in percentage exchange as the clay concentration increases and a flatter slope of the isotherms obtained against H-resin.

45. A spectrophotometric study of the System : $\text{CuSO}_4 - (\text{NH}_4)_2\text{SO}_4 \cdot \text{H}_2\text{O}$.

A. C. CHATTERJI and P. R. KRISHNAN, Lucknow.

The above system has been studied spectro-photometrically in the ultraviolet region with a view to identify complex ions using the criteria for the selection of wavelengths due to Vos Burgh Cooper and Gould. The mixed solutions were prepared according to the method of monovariation. Five distinct absorption maxima indicate that CuSO_4 and $(\text{NH}_4)_2\text{SO}_4$ form co-ordination compounds of the formulae : $\text{CuSO}_4(\text{NH}_4)_2\text{SO}_4$, $\text{CuSO}_4 \cdot 2(\text{NH}_4)_2\text{SO}_4$, $\text{CuSO}_4 \cdot 3(\text{NH}_4)_2\text{SO}_4$, $\text{CuSO}_4 \cdot 5(\text{NH}_4)_2\text{SO}_4$, and $\text{CuSO}_4 \cdot 6(\text{NH}_4)_2\text{SO}_4$.

The above conclusion is fully corroborated by the study of properties like viscosity, freezing point—depression, pH, E.M.F., absorption spectra in the visible region etc.

46. Linear velocity of Crystallisation in supercooled solutions.

A. C. CHATTERJI and J. P. MATHUR, Lucknow.

Viscosity and linear velocity of crystallisation of resorcinol in aqueous and non-aqueous solutions have been determined at various temperatures. The results are explained in the light of Frenkel's views on the velocity of crystallisation in uni-component systems.

47. Supersaturation of Liquids in Liquids.

A. C. CHATTERJI and K. SINGH, Lucknow.

Further experimental evidence has been brought forward to show that supersaturation exists in liquid-liquid systems. It has been found that the calculated values of 'r' of the stable nucleus are fairly constant. Here 'r' has been calculated for liquid-liquid systems. Hitherto the radius of the stable nucleus has been calculated only for solutions of solids or for supercooled liquids.

48. On the dependence of cataphoretic velocity, endosmotic velocity and streaming potentials on the shape and size of the particles.

S. G. CHAUDHURY, Calcutta.

An equation for cataphoresis or endosmosis or for the matter of that for streaming potentials has been developed for physical and chemical homogeneities which gives for results of cataphoresis of red blood corpuscles, white blood corpuscles, lymphocytes and gelatin particles, the accuracy of measurements of the cataphoretic velocities in a microcataphoresis cell. The velocity measured in a microcataphoresis cell is the velocity of the primary particles. If the mean of the velocities be taken, taking into consideration the domains of positive, negative and square numbers, the velocity is the true velocity and is constant at every depth. Its variation with depth in graph is therefore a straight line instead of a parabola which is usually obtained and where the velocity of depth as recognised before cannot be followed.

49. Spectrophotometric Study of the Ferric-Thiosulphate Complex—Part I.

J. DAS and D. PATNAIK, Cuttack.

Determination of the formula of the labile coloured complex formed by the reaction of thiosulphates with ferric salts by the application of Job's method of continuous variation to the optical properties of the coloured complex has been reinvestigated due to the special nature of the decay-curve. Three aqueous solutions of two ferric salts one without acid and two others with different acid contents have been used at two wave-lengths 500 m μ and 600 m μ . The maximum absorptions for the volume ratio of 1 : 1 of equimolecular solutions of ferric salt and thiosulphate without any acid confirms the formula $\text{Fe} + \text{SO}_3$. The volume ratio changed to 1 : 2 and 1 : 3 according to the different acid contents. This has been explained as due to the difference between the effective concentration and the

actual concentration of $S_2O_3^{2-}$ ion. When acidic solutions of ferric salts were used the absorptions at zero-time for wave-lengths $500\text{ m}\mu$ and $600\text{ m}\mu$ were not much different. But with solutions containing no acid, the difference was very high. The increase in absorption in case of aqueous solutions containing no acid at lower wave-length region is ascribed to be due to the polynuclear hydrolysis product $Fe(OH)_2 + Fe$. Indication for the existence of $Fe(OH)_2Fe^{2+}(S_2O_3)$ has been also given.

50. Viscosity of some complex salts in Aqueous solution.

P. K. DAS, Cuttack.

Viscosity of (1) Hexamine Cobaltic Sulphate, (2) tris-ethylene-diamine cobaltic sulphate and (3) tris-propylene-diamine cobaltic sulphate at 35°C were measured. The Jones and Dole equation is applicable in dilute solutions. The values of 'A' found are 0.045 (0.0413), 0.0518 (0.0487) and 0.0542 (0.0512); the values of 'A' derived with the Falkenhagen and Vernon's equation are given in the parenthesis. The ionic conductance of tris-propylene-diamine ion at 35°C is 83.1 ohms^{-1} .

51. Density of adsorbed water and its effect on the density of soils.

B. C. DEB and S. P. CHADHA, Poona.

Adsorbed water in a soil is held by the colloidal particles and is under considerable pressure or suction force which varies with the moisture content. It is therefore expected that the density of this water will be higher than the density of ordinary water. This will have its due effect on the values of density of soils when determined in water. For this study the density of adsorbed water at different moisture contents has been determined by finding the densities of the soil at different moisture contents and at oven-dry condition in a non-polar liquid.

It has been found that the density of adsorbed water varies from 1.054 to 1.205 for a black cotton soil at different moisture contents. The values obtained agree fairly well with the values derived on theoretical basis. The densities of oven-dry soils vary considerably when determined in water and in a non-polar liquid. The density found in water is always higher than the density obtained by using a non-polar liquid.

52. Exchangeable Aluminium in Acid Clays.

B. C. DEB and S. P. CHADHA, Poona.

The phenomenon of liberation of aluminium from acid soils and clays by neutral salts has been observed by many workers, but no explanation which satisfies all the observed facts has been yet forthcoming.

The factors responsible for bringing aluminium into solution from acid clays by neutral salt treatment have been investigated. It has been found that aluminium is liberated from acid clays as often as these are treated with salt solution and again made acid; the amount decreasing in successive treatment and finally becoming almost constant. It has also been shown that HCl produced in the exchange reaction is not responsible for dissolution of aluminium. It has been further found out that aluminium is brought into solution even when no exchange acidity is developed but sufficient amount of salt is present. Some of the results obtained have been explained on the hypothesis that acid clay is really an H-Al-clay.

53. Kinetics of oxidation of reduced iron-ore preparations by steam.

A. R. GHOSH and A. N. ROY, Khargpur.

The kinetics of oxidation of some reduced haematite ore preparations by steam was investigated in the temperature range of 550°-950°C. The ore containing about 97.4% Fe_2O_3 , was finely pulverised and pelleted with binders such as Calcium Oxide, and Sodium Silicate. To increase the porosity, a foaming agent (Igal No. 1, I.C.I.) was incorporated in some of them. The pellets were reduced in hydrogen at 550°C to almost complete reduction (92-96% Fe content).

A study of the oxidation process with various ore preparations over the temperature range of 550-950°C revealed that the rate of oxidation was on the whole greater for the foamy than the foamless material. This advantage, however was gradually lost with increase of reaction temperature, and at 950°C, the reaction-rate was almost the same. Contrary to expectation, the velocity decreased with temperature—presumably owing to sintering of reduced iron which begins at 625°C and becomes very marked in the range 800-900°C.

The curves for rate process is of the 'S' type at 550°C. This is ascribed to auto-catalysis by Fe_3O_4 which is formed instead of FeO , the temperature being below the quadruple point. In the temperature range of 750-820°C, the induction period is almost non-existent, the velocity of oxidation is maximum at the start and then gradually falls off. At 950°C, curves anomalously of 'S' type are again obtained.

Activity of incompletely reduced (65-70% Fe content) Iron-oxide material was next investigated. It was found that the velocity of oxidation is remarkably enhanced. Probably the completely reduced material being in a highly active state, is rapidly covered with a tenacious oxide film which hinders the diffusion of steam through it.

54. The Evaluation of Rate Constants of First-Order Consecutive Irreversible Reactions with the Help of Alignment Chart—Part II.

B. N. GHOSH and D. K. SEN, Bombay.

A slightly modified form of our method of evaluating rate constants for first order consecutive irreversible reactions, has been applied to the case of hydrolysis of 2, 7-dicyano-naphthalene studied by Kauffler. This is an example of observation on $(x+y)/2a$. The method here presented appears to be more general and accurate than Swain's method or the modified one as given in Kinetics and Mechanism by Frost and Pearson. It has been shown on theoretical consideration that the time for 15% reaction cannot exceed 0.3452 hour. An extension of this method of evaluating rate constants of a two steps first-order consecutive irreversible reactions in which the intermediate and the final products are the same and are obtained in the ratio μ to 1 has also been proposed.

55. Effect of Methyl Orange on the capacity of the dropping mercury electrode.

S. L. GUPTA, Kanpur.

The study of the behaviour of methyl orange at the dropping mercury electrode has revealed many new and interesting features. The most important feature is the presence of the main as well as satellite desorption peaks at pH 12.3 and absence of these satellite peaks at pH 5.0 and 1.0. These multiple peaks have been accounted for as due to changes of state of the adsorption film occurring as a result of the changes in the applied potential. It has also been observed that at pH 12.3, the main peak changes its magnitude which indicates micelle formation.

56. Preliminary investigations on the nature of the capacity peaks observed with organic compounds at the dropping mercury electrode in pulsating field.

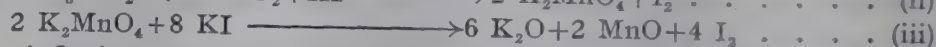
S. L. GUPTA and S. K. D. AGARWAL, Kanpur.

Preliminary investigations have been made for determining the nature of the capacity peaks observed with organic compounds at the dropping mercury electrode in pulsating fields. The peaks may be broadly classified into those caused by (1) desorption and those caused by (2) Chemical reaction such as reduction or oxidation. In this investigation it has been seen how far a change of the indifferent electrolyte can elucidate the nature of the peak. The observations show that the effect of changing over the indifferent electrolyte from KCl to KI reveals the following features. Class 'A' shows no appreciable change either in the position or in the magnitude of the peaks. Such peaks may be identified as generally caused by chemical reaction; class 'B' shows peaks at nearly the same voltage but with decreased or increased magnitude when KI is used instead of KCl. Such peaks may be identified as generally caused by desorption.

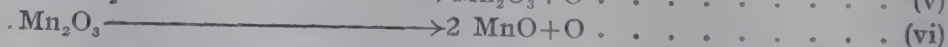
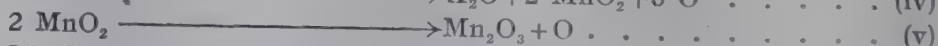
57. Reduction of KMnO_4 by KI and KBr in presence of sulphuric acid.

B. P. GYANI, Patna.

Potassium permanganate in sulphuric acid solutions (N/10 to 6 N) was titrated potentiometrically with KI and KBr. Two unusually sharp inflexions were observed in the titrations with KI, the first at half to one mole KI per mole KMnO_4 , and the second which is not variable with concentration of acid, at 5 moles KI. The following reactions are indicated:



The inflexions are also variable in the titration with KBr and indicate the following reactions:



Although the final inflexion at 5 mols KI is independent of acid concentration, it is variable in the case of KBr. The titre decreases to 4.5 moles KBr at high acid concentrations. (5-8 N).

58. Reduction of KMnO_4 by KI and KNO_2 in presence of dilute HCl.

B. P. GYANI, Patna.

Potentiometric titration of KMnO_4 in presence of dilute HCl (N/30 to N/10) with KI gives two inflexions at half and five moles KI so that the reactions indicated are:



The titration with KNO_2 gives inflexions at 1.5 and 2.5 moles KNO_2 per mole KMnO_4 indicating the reactions:



The inflexions are steep and invariable in the acid concentrations chosen, so that they may be used for practical analytical purposes.

59. Dipole moment and absorption spectra—Part I.

S. K. K. JATKAR and V. K. PHANSALKAR, Poona.

The dipole moments of aniline o-m-, and p-toluidine, α -and- β -naphthylamine were determined in pure state by using the equation given by Jatkar et al. All the values were practically independent of temperature.

The ultra-violet absorption spectra of the above compounds were measured on Beckman DU quartz spectrophotometer using alcohol and dioxane as the solvents.

When the values of the dipole moments and λ max. of these compounds are plotted parallel straight lines are obtained.

60. Studies of Absorption and Fluorescence spectra of complex compounds of Boron, Zirconium and Uranium.

S. K. K. JATKAR and MISS R. M. KARNIK, Poona.

The absorption and fluorescence measurements were taken on a Beckman Spectrophotometer and fluorimeter respectively. The fluorimeter was constructed in this laboratory and consisted of IP28 photomultiplier tube, a stabilised power pack and a single stage valve amplifier. An ultraviolet mercury lamp was a source of excitation and a constant deviation spectroscopy was used for the analysis of fluorescence spectra.

Boron gave a greenish-white fluorescence on addition of benzoin in slightly alkaline 85% ethyl alcohol solution.

A blue fluorescence was given by Zirconium with simple flavonol in sulphuric acid solution.

Green fluorescence was observed in the uranyl salt solution. The intensity of fluorescence was greater in phosphoric acid than in sulphuric acid or water.

The fluorescence and absorption spectra of solutions containing reagent and complex compound were measured under optimum conditions.

61. Studies in double salts.

S. K. K. JATKAR and S. S. KATTI, Poona.

Physico chemical properties of double salts of the chlorides of cobalt, copper, iron and chromium with chlorides of Hydrogen, Potassium, Sodium, Ammonium, Calcium, Magnesium, Zinc and Mercury have been studied by potentiometry and conductometry.

The results are interpreted in terms of changes in hydration number and complex anion formation. The above studies also confirm the findings of the previous workers that there exists a transition series of complex ions between the hydrated ions on one hand and complex ions such as amines, cyanides on the other hand.

The authors have constructed a high precision conductivity bridge with separate wagner earthing circuit, to avoid stray pick up and to increase the accuracy of the balance point.

62. Absorption and fluorescence of 4-4'-diaminostilbene-2-2'-disulphonic acid. Determination of basic dissociation constants of the diamine by a spectrophotometric method.

S. K. K. JATKAR and B. N. MATTOO, Poona.

Absorption and fluorescence spectra of 4-4'-diaminostilbene-2-2'-disulphonic acid have been studied. The absorption in u.v. has two bands at 337 and 222 m μ in

neutral media, but the intensity and the position of these vary with pH in acidic media. The formation of $-\text{NH}_3^+$ in acid solution reduces resonance, thereby reducing absorption and affecting the fluorescence adversely. The diamine is strongly fluorescent in neutral and alkaline media and the spectrum covers the range 4000-6100 \AA with maximum at 470 $\text{m}\mu$.

The pH-variation of the absorption spectrum has been utilized in the determination of the basic dissociation constants of the $-\text{NH}_2$ groups of the diamine. There is no interference due to $-\text{SO}_3\text{H}$ groups which have very little effect on absorption. The spectrophotometric determination of the ionization constants gives the values $\text{pK}_1=9.58$ and $\text{pK}_2=11.22$ at 26°C .

63. Reduction of Potassium permanganate in Heterogeneous System.

P. S. JAVADEKAR, Sangli.

A reaction between benzaldehyde in benzene and aqueous acidified potassium permanganate has been studied, varying concentration of benzaldehyde and potassium permanganate at different temperatures and speeds of stirring. The reaction velocity increased with increase in the concentration of benzaldehyde and decreased with increasing concentration of permanganate. The reaction is strongly autocatalytic. Manganese, Nickel, and Cobalt Sulphates were added to the aqueous phase as catalysts; this addition had hardly any influence on the reaction velocity although these are very good catalysts in homogeneous systems.

64. Differential thermal analysis of catalyst powders : System $\text{SiO}_2\text{-Al}_2\text{O}_3$.

Miss S. KAMESWARI and S. K. BHATTACHARYYA, Kharagpur.

The thermal behaviour of binary mixtures of silica and alumina, which are important catalysts in the catalytic cracking of oils, was studied by D.T.A. in connection with catalytic activation and stabilizing effect of silica on alumina.

Silica gel exhibits a low temperature endothermic peak at 140°C due to the loss of adsorbed water and alumina gel exhibits two endothermal peaks. The low endothermal peak at 145°C is due to the loss of adsorbed water and the second one at about 448°C is due to the formation of $\gamma\text{-Al}_2\text{O}_3$.

The co-precipitated as well as mechanically prepared samples containing low percentages of Al_2O_3 show a single endothermic peak in the range $90^\circ\text{-}170^\circ\text{C}$, whereas those with higher Al_2O_3 contents exhibited in addition a higher temperature endothermal peak at about 300°C .

D.T.A. of the system $\text{SiO}_2 : \text{Al}_2\text{O}_3$ at different pH values indicates that two instead of a single endothermic peak are obtained at higher pH values.

It is concluded that lower alumina contents in the mixture and lower pH values during precipitation enhance the inhibition action of SiO_2 gel on the gibbsite structure.

65. Catalytic decomposition of potassium chlorate in the presence of mixture of catalysts.

G. B. KOLHATKAR and L. M. APTE, Poona.

Mixtures of nickel sulphate with chromium sulphate, manganese sulphate and cobalt sulphate are used as catalysts to decompose potassium chlorate and it is found that the mixtures act less effectively than the individual components of the mixture, when each acts alone. The temperature coefficients of the decomposition are also determined.

66. Interfacial tension of liquids.

P. M. KRISHNA and D. VENKATESWARLU, Kharagpur.

The drop weight method is one of the common methods used for the determination of interfacial tension of liquids. The details of this method are worked by Harkins, Humphery and Brown who described the apparatus, indicated the precautions to be adopted and gave correction factors as functions of the diameter of the capillary and volume of the drop formed.

In this paper, the limitations of the method of Harkins and Brown are pointed out and a suitably modified apparatus is presented. With a modified apparatus, the drops are formed under a constant hydrostatic head and the readings may be obtained more readily. The apparatus may also be used for the determination of surface tension of liquids. Interfacial tension values of sixteen organic liquids determined with this modified apparatus are reported.

67. Cell Permeability to barbiturates.

V. R. KRISHNAN, Sholapur.

The influence of the molecular volumes of six barbiturates on their access through cell membranes has been considered from the point of view of the pore theory of membrane structure. It has been shown that molecular size has no relevance to the rate of their permeation (related to their speed of action). The ionization constants of the acid barbiturates are found to be related to their speed of action, indicating faster penetration across membrane of the less ionized barbiturates.

68. Mathematical theory of liesegang rings based on the Phenomena of Restricted diffusion.

PREM BEHARI MATHUR and SATYESHWAR GHOSH, Allahabad.

The previous theories of Liesegang rings consider either supersaturation or colloidal formation or formation of third reaction product as an essential condition for the periodic precipitation but the experimental facts gathered so far prove conclusively that ring formation takes place even in the absence of these conditions.

In the present paper we have considered the formation of Liesegang rings purely a diffusion process, in which the free diffusion of ions is obstructed by the resisting forces of medium and that of the solid substance separated out as a result of the contact of two electrolytes one diffusing from above and the other present in the medium. A simple relation for Liesegang rings has been obtained :

$$\alpha X_n$$

$$X_n - X_{n-1} = K.e$$

where α and K are constants depending upon various factors and X_n and X_{n-1} are the distance between any two consecutive rings. The theory predicts the formation of finer fringes in between the precipitate rings and also throws light on the growth of the precipitate.

69. The reaction between Ferric Chloride and Potassium Thiocyanate.

Miss RANI MISRA and B. P. GYANI, Patna.

The reaction between dilute solutions of ferric chloride (0.003M) and potassium thiocyanate (0.1 N and above) has been studied. The red colour produced appears to be precisely identical with that produced by AmCNS at the same concentrations

provided they are not large. The rate of fading in different mixtures (variable concentrations of thiocyanate) is also similar even when acid is present. Saturated AmCNS produces a deeper colour than saturated KCNS although the latter is more soluble. The rate of fading in the latter case is abnormally large at 35-36°C. When the concentration of FeCl_3 is about 0.006 M addition of 1% thiocyanate does not produce colour. The mixture becomes red as soon as it is acidified. $\text{K}_4\text{Fe(CN)}_6$ also fails to produce a colour from dilute FeCl_3 and thiocyanate mixtures unless the mixture is acidified. If saturated ammonium thiocyanate is present the blue colour appears slowly and is distinct only after several hours. It may be possible to explain these facts on the basis that iron is linked up in chains of variable length both in dilute FeCl_3 and in mixtures with thiocyanate. Fading of the red colour is due to lengthening of the chain as well as reduction of Fe^{+++} to Fe^{++} ions.

70. Cadmium acetate complex in Aqueous Solution.

S. S. MITRA and S. N. BANERJEE, Kharagpur.

In this paper the value of the thermodynamic constant K , for the equilibrium,

$$\text{Cd Ac}^+ \rightleftharpoons \text{Cd}^{++} + \text{Ac}^-$$

has been determined by studying the equilibrium hydrogen ion concentration in a mixture of equimolar amounts of cadmium sulphate and acetic acid solutions. Assuming a complete dissociation of cadmium sulphate, the value of K has been determined by the application of "law of mass action", taking into account the activity coefficients for the individual ions, calculated from the ionic strength of the solution mixtures applying the "Debye Huckel limiting law".

The value of $K = 8.9 \times 10^{-2}$ given by us however differs from that ($K = 1.7 \times 10^{-2}$) given by Aditya and Prasad (Jour. Indian Chem. Soc. 30, 255, 1953) considerably.

It is however, not known whether cadmium sulphate is completely dissociated in aqueous solution and hence, it is not possible to judge which of the two values are more correct. In order to decide the issue we are repeating the experiment with cadmium nitrate, which has been taken by Aditya and Prasad (Part IV loc. cit) to be completely dissociated.

71. Calcium and Sulphur from Sea Spray.

A. K. MUKHERJEE, Jodhpur.

Miyake measured the ratio of Ca/SO_4 in rain water, fog water, etc. and concluded that the sparing solubility of CaSO_4 compared to CaCl_2 , Na_2SO_4 , etc. is responsible for the higher ratio compared to that in the sea water itself. Miyake's idea has been further extended here and it has been anticipated that where there is no extraneous source of sulphur (specially in coastal regions) at lower heights from the sea level (0.44 km) the Ca/S ratio agrees closely to the theoretical figure in CaSO_4 .

72. Conductivity and pH of Monsoon Rain Water.

A. K. MUKHERJEE, Jodhpur and S. N. MUKHERJEE, Calcutta.

Specific conductivity and pH of some samples of monsoon rain water were studied at Jadavpur, Calcutta. The values of conductivity varied between 0.66×10^{-5} mhos to 3.72×10^{-5} mhos. The pH values varied between 6.80 and 7.42. Conductivity of rain water decreases as rain continues but increases towards the end as it becomes very light. A comparison of these data with those obtained in England shows that monsoon rain water here is purer as it has got less conductivity.

73. Absorption studies in aqueous solutions of Yeast Nucleic Acid and its Sodium Salt in the Ultraviolet.

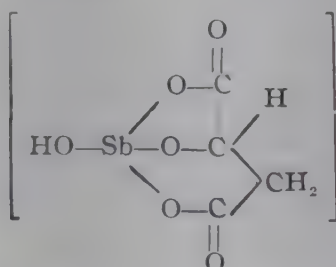
S. N. MUKHERJEE, Calcutta.

Aqueous Solutions of Yeast Nucleic acid and its Sodium salt at different concentrations were irradiated by ultraviolet radiations of different wavelengths (365, 260, 253.7 and 230 $m\mu$) for different periods of time ranging from 1 hour to 24 hours. No change was perceptible in any case in any of the concentrations excepting in 253.7 $m\mu$ in which dilute solutions of the acid (0.025 and 0.01%) on irradiation for more than 8 hours showed signs of change in depressing the absorption peak at 260 $m\mu$, the more dilute solutions showing the greater effect. Addition of acids (HCl, CH_3COOH and H_3PO_4) even in high concentrations failed to produce any change in the nature and the magnitude of the maxima in the absorption curves even to a slight extent, although addition of bases could produce a shift in the absorption peak by 5 $m\mu$ towards the side of longer wave lengths.

74. Malate Complex of Trivalent Antimony.

CH. B. NANDA and S. PANI, Cuttack.

The evidence of the existence of a malate complex of trivalent antimony containing one malate ligand per atom of antimony has been obtained by solubility method. The complex is most probably



The equilibrium constant of the reaction by which the complex is formed from the antimonyl ion and malate ion is determined. The mean value of the constant is 1.730×10^7 .

75. Potentiometric Titration of 1 per cent Aqueous Solutions of Crystalline and Non-Crystalline Egg-Albumin with (i) Ortho-Phosphoric Acid and (ii) Glycero-Phosphoric Acid Respectively.

C. S. NARWANI and V. G. SOHONI, Bombay.

On determining the pH values of 1% aqueous solution of Crystalline Egg-Albumin containing 0.002 to 0.020 M solutions of Ortho-phosphoric acid and Glycero-Phosphoric acid respectively, it is observed from the inflections of titration curves that the amount of H ions combined with one gm. of the protein is 60.25×10^{-5} gm-equivalents in case of ortho-phosphoric acid, and 67.65×10^{-5} gm-equivalents in case of glycero-phosphoric acid. One gm. of Merck's Ovalbumin combines with 76.77×10^{-5} gm-equivalents of H ions in case of ortho-phosphoric acid and with 83.06×10^{-5} gm-equivalents of H ions in case of glycero-phosphoric acid.

76. Effect of Neutron Irradiation on Bromobenzene.

R. P. PONCHA and HARI D. SHARMA, Bombay.

It has been shown that the effect of pH of the extracting solution is negligible on the value of organic yield in bromobenzene following the (n, γ) reaction contrary

to the expectations of Chien and Willard. The value of organic yield is affected by the presence of impurities and the material of the container used for irradiation.

77. Reduction of Mercuric Chloride by Oxalic Acid in dark in presence of Potassium Permanganate as inductor.

CHANDRIKA PRASAD, Agra.

Reduction of mercuric chloride by oxalic acid induced by potassium permanganate in dark has been studied from the viewpoint of concentration effect of the inductor on the induction period and the extent of reduction of mercuric chloride. The induction period has been found to remain almost constant upto a certain concentration of the permanganate beyond which it gradually increases. When the concentration of the permanganate exceeds a certain limit, manganese dioxide is precipitated and the induction period is much increased. By increasing the concentration of the inductor the reduction of mercuric chloride increases, but this reduction per mol of potassium permanganate at first increases rapidly and then gradually decreases.

In the light of the foregoing observations it has been suggested that the reduction of mercuric chloride is brought about through the mechanism of heterogeneous catalysis due to the activation of the reacting molecules on the surface of the colloidal manganese dioxide formed by the action of potassium permanganate on oxalic acid. This view is supported by the fact that when different amounts of colloidal manganese dioxide are added to a mixture of mercuric chloride and oxalic acid the induction period remains almost the same and very much less (hardly 2 to 3 minutes) while the extent of reduction of mercuric chloride increases with higher concentrations of colloidal manganese dioxide as observed when potassium permanganate is used as inductor. The influence of change of temperature also supports the view suggested above.

78. Differential Thermal Analysis of TiO_2 GELS.

V. S. RAMACHANDRAN and S. K. BHATTACHARYYA, Kharagpur.

Differential Thermal Analysis of titania gels prepared by several methods have been carried out.

All the samples exhibit a low temperature endothermic peak at a temperature of about 200°C due to the loss of adsorbed water. Thermograms fail to show any indication of hydrate formation.

The gels prepared by the hydrolysis of sulphate solution show two exothermic peaks at 375° and 510°C which may correspond to the formation of anatase and brookite respectively. A single exothermal effect, corresponding to the formation of anatase is indicated in the thermograms of gels obtained from titanium chloride and potassium fluorotitanate solutions.

The samples prepared by the hydrolysis of $\text{Ti}(\text{SO}_4)_2$ as well as those precipitated from chloride solution show exothermal effects above 800°C which probably represent the formation of rutile TiO_2 .

Addition of certain agents like potassium hydroxide, barium phosphate and sodium thiosulphate seems to promote crystallisation to anatase structure, at the same time retarding the formation of rutile modification.

The anatase form seems to be inactive for hydrogenation whereas it is a good catalyst for decomposition of esters of secondary alcohols.

79. Effect of Solvent on the Polarographic Behaviour of m-Iodobenzoic Acid.

C. S. RAMANATHAN and R. S. SUBRAHIMANYA, Bangalore.

The diffusion currents of m-iodobenzoic acid in various aqueous mixtures of ethanol, dioxane and acetone were determined. Lithium chloride was used as the indifferent electrolyte. These determinations were made in solutions of different pH values. The diffusion currents decreased as the concentration of the organic solvent in the base electrolyte was increased. The wave forms were also affected by the solvent concentration. There was good proportionality between the diffusion current and the concentration of m-iodobenzoic acid. The diffusion coefficients of the substance under investigation were measured under polarographic conditions. The number of electrons involved in the reduction, calculated on the basis of the Ilkovic equation, was found to be two in all the cases. From the point of view of analysis, 50% dioxane may be employed, with which an accuracy of $\pm 2\%$ could be obtained.

80. Kinetics of Thermal and Photochemical Oxidation of Alcohols by Chromic Acid.

(Miss) K. K. ROHATGI, Calcutta.

Thermal and photochemical oxidation of glycerol has been studied at temperatures of 15°C , 25°C , and 35°C and buffered at pH values of 5.1, 4.25, and 3. Unbuffered solution (pH 4.35) was also studied. The progress of reaction was followed by colorimetric estimation of violet complex of Cr^{+++} formed on heating with disodium salt of ethylene diamine tetra-acetic acid (Pribil). The activation energy is about 25530 cal/gm mole at pH 4.25, and much less at pH 3, the value being 7309 cal/gm. mole. It seems that H^+ ion is also acting as a catalyst in thermal oxidation process. The quantum efficiency of photochemical reaction showed small negative temperature co-efficient.

The rates of thermal and photochemical reactions, both vary with hydrogen ion concentration but the nature of variation is not the same in both the cases. For the case of photochemical reaction, by using the value of $K_2 = 3.9 \times 10^{-7}$ (Vitterbi and Krauz) for the equilibrium $[\text{H}^+][\text{CrO}_4^{--}] \rightleftharpoons [\text{HCrO}_4^-]$, the concentrations C_1 and C_2 of HCrO_4^- and CrO_4^{--} have been calculated. From the known values of E_1 and E_2 , the extinction co-efficients of HCrO_4^- and CrO_4^{--} respectively, the percentage of light absorbed by HCrO_4^- only, has been obtained. If the above equilibrium is supposed to be the rate controlling step and the hydrochromate ion as the photoactive species, as suggested by Bowen et al, then the Q.E. of oxidation should be proportional to the light absorbed by HCrO_4^- . It is found that practically cent per cent light is absorbed by HCrO_4^- . In that case Q.E. should be independent of $[\text{H}^+]$. But actual experiments show definite increase in Q.E. with $[\text{H}^+]$. Therefore the above equilibrium cannot be the rate controlling step.

81. A Spectrophotometric Study of the Stability of Ascorbic Acid.

(Miss) K. K. ROHATGI, Calcutta.

A spectrophotometric study of the rate of deterioration of ascorbic acid has been made at pH values ranging from 2.4 to 8.0 using McIlvain's citric acid— Na_2HPO_4 buffer solutions. The complete absorption curves of each solution was measured in Beckmann Quartz spectrophotometer after intervals of about 44 hrs., 92 hrs., and 314 hrs. and the rate of deterioration calculated. In the first 44 hrs. the solutions at pH values 2.45, 3.38, 4.10 and 5.0 decomposed at the same rate. Deviations were observed on keeping for longer time. At pH 6.0, the solution

showed practically no decomposition in first 44 hrs. and after that it decomposed gradually. At pH 7.0, the decomposition was very rapid from the beginning. The results indicate that ascorbic acid is more or less stable in acid range with maximum stability at pH 6.0 and minimum stability at pH 7.

Complete absorption curve of the acid was also obtained in more comparable condition using the same buffer mixtures. The nature of the absorption curve was found to vary with the pH of the solution. At pH 1 (in 0.2 N HCl) λ max. lies at 243 m μ and gradually shifts towards longer wavelength with increase of pH value. The shift was not considerable for pH 1.0, 2.3, and 3.38. λ max. at pH 4.1 is found at 258 m μ whereas at pH 5.0, it is obtained at 265 m μ . Any further increase in pH no longer produces any shift. But the extinction co-efficient rises sharply reaching a maximum value at pH 6.0 and decreasing again at pH 7.0 and 8.0. The observation that the maximum stability and the minimum extinction coefficients, both are found at the same pH value viz. 6.0 may have some significance.

82. On the evaluation of Fluctuation Terms in the Potential Energy Equation of Strong electrolyte Solution.

RANAJIT SEN GUPTA, Kharagpur.

In order to establish the equivalence between the Debye-Hückel theory with the usual statistical mechanical procedure, it is necessary to use the following two assumptions (Fowler 1927)

$$(1) \quad W_{\alpha\beta} = Z_{\alpha}|e| \bar{\Psi}^{\beta-} = Z_{\beta}|e| \bar{\Psi}^{\alpha-} = W_{\beta\alpha}$$

$$(2) \quad \frac{1}{RT} \left[(\text{grad } W_{\alpha\beta})^2 - \overline{(\text{grad } W)^2} \right] = 0$$

where $W_{\alpha\beta}$ is the statistical average interaction between α and β defined by

$$Q e^{-W_{\alpha\beta}/RT} = \int \dots \int Q e^{-W/RT} \pi''(dw) N. \quad (v)$$

and the other terms having the usual meaning.

Regarding the second approximation, so far no method was available to estimate the magnitude of this expression. The present author has found the following method by using a result obtained by M. Dutta in connection with his theory of imperfect gases. One can relate $(\text{Grad } W_{\alpha\beta})^2$ by $(\text{grad } W)^2$ by the expression—

$$(\text{grad } W)^2 = \frac{4\Lambda^2 + \Lambda^2 - V^2}{N^2} \left\{ -\frac{\Lambda_+}{V} - \frac{\Lambda_-}{V} + \frac{2\Lambda_+ \Lambda_-}{N} V e^{W_{\alpha\beta}/RT} \right\}^2 e^{2W_{\alpha\beta}/RT} (\text{grad } W_{\alpha\beta})^2$$

Λ_+ and Λ_- are constants related to the volume of the ions. The above results enable one to write the complete potential equation

$$\begin{aligned} \Delta^2 W_{\alpha\beta} = & -\frac{4\pi}{DV} Z_{\beta}|e| \sum_p Z_p Z_{\beta}|e| e^{-W_{\alpha\beta}/RT} \\ & + \frac{1}{RT} (\text{grad } W_{\alpha\beta})^2 \left\{ 1 - \frac{4\Lambda^2 + \Lambda^2 - V^2}{N^2} e^{2W_{\alpha\beta}/RT} \right. \\ & \quad \left. - \left(-\frac{\Lambda_+}{V} - \frac{\Lambda_-}{V} - \frac{2\Lambda_+ \Lambda_-}{N} V e^{W_{\alpha\beta}/RT} \right)^2 \right\} \end{aligned}$$

and this equation has to be considered (instead of the usual Poisson-Boltzman equation) if one intends to take into account the effects of the fluctuation terms in the behaviour of strong electrolytes

83. On the solution of Poisson—Boltzman equation.

RANAJIT SEN GUPTA, Kharagpur.

It has been pointed out that Debye method of solving the Poisson-Boltzman equation is wrong, since the neglected terms are much greater than the retained terms in the regions in which we are interested. The modification by Gronwal and La Mer and others is also not free from such criticisms.

However, it is possible to get an *exact* value of the potential on the surface of the ion concerned, and since to calculate activity coefficients etc. we are interested in finding the value of the potential only at this region, we need not find out the actual solution of the Poisson-Boltzman equation as such. For the purpose of the present note, we consider following equation,

$$\Delta^2 \frac{W_{\alpha\beta}}{Z_{\beta}|e|} = -\frac{4\pi}{DV} \Sigma_{\beta} Z_{\beta}|e| e^{-W_{\alpha\beta}/RT} \dots \dots \dots (1)$$

which occurs in the "Self consistent" theory of Strong electrolytes proposed by the present author, instead of the usual P.B. equation. The latter might easily be solved by the same method with somewhat less trouble because the boundary conditions are simpler. Here, Z_{β}/e is the charge of ions concerned, D the dielectric constant, V the volume of the assembly and $W_{\alpha\beta}$ is the potential energy between two molecules α and β . This has to be solved to satisfy the following two boundary conditions :—

$$-D \left[\frac{\delta}{\delta r} \left(\frac{W_{\alpha\beta}}{Z_{\beta}|e|} e^{W_{\alpha\beta}/RT} \right) \right]_{r=a} = \frac{Z_{\alpha}|e|}{a^3} \dots \dots \dots (2)$$

where a is the radius of the ions considered and

$$\int_a^{\infty} \alpha \overline{\rho(r)} 4\pi r^2 dr = -Z_{\alpha}|e| \dots \dots \dots (3)$$

where $\rho(r)$ is the average of the radial density function defined by

$$\alpha \overline{\rho(r)} = \frac{1}{V} \Sigma_{\beta} Z_{\beta}|e| e^{-W_{\alpha\beta}/RT} \dots \dots \dots (4)$$

Let us now write $W_{\alpha\beta} = W^*_{\alpha\beta} + \Delta W_{\alpha\beta}$ where $W^*_{\alpha\beta} = \frac{A}{r}$, we choose A in such a way that the boundary condition obtained by replacing $W_{\alpha\beta}$ by $W^*_{\alpha\beta}$ in the equation (2) is satisfied. If $u = e^{-\Delta W_{\alpha\beta}/RT}$ where we have, (if we assume only the radial interaction),

$$\frac{d^2 u}{dr^2} - \frac{1}{u} \left(\frac{du}{dr} \right)^2 + \frac{2}{r} \frac{du}{dr} = -\frac{4\pi}{DV} \Sigma_{\beta} Z_{\beta}|e| e^{-W_{\alpha\beta}/RT} \dots \dots \dots (5)$$

subject to the boundary condition

$$\left[\frac{d(\Delta W_{\alpha\beta}/Z_{\beta}|e|)}{dv} \right]_{r=a} = 0 \dots \dots \dots (6)$$

and (3). Therefore if we choose instead of equation (5) the equation

$$\frac{d^2 W}{dv^2} = -\frac{4\pi}{DV} \Sigma_{\beta} Z_{\beta}|e| e^{-W_{\alpha\beta}/RT}$$

we notice that at $r \rightarrow a$, $w \rightarrow u$. Hence the value of the potential energy function when r approaches a is obtained by solving (7). Application of boundary condition (6) is straightforward and to apply (3) we notice at $r \rightarrow \infty$, $\alpha \overline{\rho(r)} \rightarrow 0$ and hence

$$\int_a^{\infty} \alpha \overline{\rho(r)} 4\pi r^2 dr = \left[\frac{1}{V} \int \Sigma_{\beta} Z_{\beta}|e| e^{-\frac{A}{RT} W(r)} dr \right]_{r=a}$$

and the determination of all the arbitrary constants now become possible.

84. Effect of Neutron Irradiation on o, m and p—Bromonitro Benzene.

HARI D. SHARMA and C. L. RAO, Bombay.

The values for organic yield in o, m and p bromonitro benzenes irradiated with neutrons have been determined for both $\text{Br}^{80\text{m}}$ and Br^{82} following two procedures. The value for the organic yield has been found to be lower if inorganic activity is extracted by hot water from the melted compounds as compared to the one obtained by dissolving the compounds in benzene and subsequent extraction with cold water. The organic yield for Br^{82} has been found to be lower than that of $\text{Br}^{80\text{m}}$. The results given above have been discussed.

85. Kinetics of Oxidation of Glucose, Galactose and Fructose by Bivalent Copper in presence of Tartrate.

MATHURA PD. SINGH, BAL KRISHNA and SATYESHWAR GHOSH, Allahabad.

In this paper we have studied the oxidation of dextrose, galactose and fructose by Fehling's solution and the following facts have been observed.

- (1) The reaction is unimolecular with respect to the reducing sugar.
- (2) It is zero molecular with respect to copper present in the solution as complex cation.
- (3) The reaction velocity is independent of the concentration of Rochelle salt. The minimum amount of tartrate required is in the ratio of 1:1 of copper sulphate to form the complex.
- (4) The reaction is highly catalysed by the hydroxyl ions. The increase in velocity constant is however not proportional to hydroxyl ions concentration.
- (5) The reaction has an induction period.
- (6) The previous treatment of the alkali enhances the reaction rate in the case of aldehyde sugar (dextrose and galactose) and retards the reaction speed in the case of ketosugar (fructose). The induction period remains with all the reducing sugars.
- (7) The following is the order observed in the reaction speed of dextrose, galactose and fructose.

fructose > dextrose > galactose.

- (8) It is suggested that the rate determining step in the reduction of Fehling's solution by reducing sugars is the action of alkali on the sugar molecule producing intermediate enediol.

86. Kinetics of Reduction of Bivalent Copper by Reducing Sugars. Part II. Reduction by L-Arabinose and D-Xylose.MATHURA PRASAD SINGH, BAL KRISHNA and SATYESHWAR GHOSH,
Allahabad.

In this paper the authors have studied the reduction of bi-valent copper by l-arabinose and d-xylose in presence of sodium potassium tartrate and sodium citrate in alkaline medium. The summary of the results is given below:

- (1) The reaction is unimolecular with respect to the reducing sugar and zero-molecular with respect to the copper complex.
- (2) Excess of tartrate or citrate has no specific effect on the reaction speed. They produce soluble copper complexes in alkaline medium.
- (3) The reaction velocity is enhanced by increasing the amount of alkali but it is not directly proportional to hydroxyl ions concentration.

The previous treatment of the sugars with alkali leads to enhancement of the reaction velocity which is due to Lbryde Bruyn transformation proving thereby that a rearrangement takes place in sugar molecule in alkaline medium prior to its oxidation.

(4) The two optical isomers of pentoses have different speed of reduction under identical conditions. The d-xylose has a faster speed than l-arabinose.

(5) From our results on the reducing action of four different reducing sugars, it is concluded that intermediate inediol is formed in the presence of an alkali which reacts with the copper complex immediately giving a zeromolecular nature of the reaction.

87. Dipole moments and Molecular structure of Barbituric acid and its derivatives.

S. SOUNDARARAJAN and K. R. KRISHNASWAMI, Bangalore.

A study of the dipole moments of barbituric acid and eight of its 5:5' substituted derivatives in dioxan solution reveals that barbituric acid (1.04D) exists in the lactam structure in dioxan solution. Also there has been found to be a close correlation between the thermodynamic dissociation constants and the dipole moments of the 5:5' substituted acids, though the quantitative nature of the relationship could not be ascertained. In the case of alloxan monohydrate the linear relationship between ϵ , d and concentration bespeaks of the existence of the molecule as dihydroxy-barbituric acid, i.e., the molecule of water in alloxan monohydrate is chemically bound and not water of crystallisation and the observed moment (2.10D) corresponds to a structure wherein hydrogen bonding of the type $O_x-H_i-O_y$ and O_y-H_z-O (attached to carbon 4) can occur.

88. Periodide formation and Association in water-alcohol mixtures.

N. R. SUBBARATNAM and A. K. BHATTACHARYA, Saugor.

Addition of ethyl alcohol to very dilute solutions of Iodine in water is shown to result in the increased production of periodides. The change in the absorption spectra was studied varying the proportions of water and alcohol. Complete disappearance of the normal iodine maxima in the visible and a significant increase in the ultraviolet maxima of the periodide ions at $350m\mu$ and $290m\mu$ occur at a concentration of about 28% alcohol by volume. This has been explained from the point view of the breaking up of the association of water molecules or complete depolymerisation of them by the molecules of alcohol and only above this concentration the alcohol molecules being free to react with iodine forming more periodides. The calculations of Butler also show that the depolymerisation is complete at a ratio of 8 molecules of water to each alcohol molecule, which corresponds to 29.3% alcohol by volume.

89. Polarographic behaviour of Iron in Pyrophosphate.

R. S. SUBRAHMANYA, Bangalore.

The polarographic behaviour of Iron has been studied at various pH values and in the presence of the following electrolytes : (1) sodium hydroxide, (2) sodium carbonate, (3) sodium acetate and (4) ammonium chloride and ammonium hydroxide. It has been noticed that below pH 10.4, the polarograms consist of two waves both corresponding to the reduction of ferric to ferrous. With a decrease in pH, the height of the first wave first increases, then remains constant and

again increases. The results are explained on the assumption of the formation of different species of complexes at different pH values. The first wave is reversible while the second wave is irreversible. The addition of potassium nitrate has a suppressive effect on the first wave. Solutions containing sodium carbonate and pyrophosphate are yellow in colour indicating the presence of colloidal hydrous ferric oxide. Only one wave corresponding to the reduction of ferric to ferrous ion is noticed. In ammonia-ammonium chloride solutions, only one irreversible wave corresponding to the reduction of ferric to ferrous is noticed.

Evidence has been found for the formation of $\text{Fe}(\text{P}_2\text{O}_7)^-$.

It has been suggested that a combination of potassium nitrate with gelatin could be employed to estimate iron polarographically in presence of pyrophosphate.

90. Polarographic behaviour of cadmium, copper, lead, nickel, cobalt, zinc and iron in Ethanolamines and Potassium Sulphate or nitrate.

R. S. SUBRAHMANYA, Bangalore.

The polarographic behaviour of ethanolamine complexes of cobalt, nickel, zinc, cadmium, iron, lead and copper has been studied in presence of potassium sulphate or nitrate. Evidence is obtained for the formation of the following complexes, where (Moen) represents Monoethanolamine, (Dien) represents Diethanolamine and (Trien) represents Triethanolamine :

- | | |
|-------------------------------|--------------------------------|
| 1. Cd (Moen) ₃ ++ | 9. Ni (Dien) ₃ ++ |
| 2. Cd (Dien) ₃ ++ | 10. Ni (Trien) ₃ ++ |
| 3. Cd (Trien) ₃ ++ | 11. Co (Dien) ₃ ++ |
| 4. Cu (Moen) ₃ ++ | 12. Co (Trien) ₃ ++ |
| 5. Cu (Dien) ₃ ++ | 13. Zn (Moen) ₃ ++ |
| 6. Pb (Moen) ₃ ++ | 14. Zn (Dien) ₃ ++ |
| 7. Pb (Dien) ₃ ++ | 15. Zn (Trien) ₃ ++ |
| 8. Ni (Moen) ₃ ++ | |

91. Bond Parachors. Part: I.

A. M. TALATI, Petlad.

Vogel, *et al.* (*J. Chem. Soc.*, 1952, 514) have calculated the bond parachor values for numerous types of bonds between different types of atoms. The author has shown in the present paper that the observed parachor values of the branched chain paraffins are considerably lower than those obtained by using Vogel's values. The anomaly can be explained by adopting corrections for "no-bond interactions". The author has recalculated the bond parachor values for the bonds C—C and C—H and the "no bond interaction correction" for C—C—C is suggested.

92. Bond Parachors. Part : II.

A. M. TALATI, Petlad.

Vogel, *et al.* (*J. Chem. Soc.*, 1952, 514) have suggested different bond parachor values for the bond C—N in aliphatic primary, secondary and tertiary amines. The author has shown that only one value of the bond C—N can be obtained if allowance is made for the no bond interaction. The bond parachor values for the bonds C—N and N—H and the no bond interaction corrections for C—C—N and C—N—C are suggested by the author and applied to the calculation of the parachor values of lower members of the aliphatic amines.

93. Studies on Parachor. Part : VI.

A. M. TALATI, Petlad.

Group parachor values for the groups $(C)CH_2NHCH_2(C)$ and $(C)_2CHNHCH(C)_2$ have been evaluated from the known parachor values of aliphatic secondary amines. The differences between the parachor values of CH_3NHCH_3 , $(C)CH_2NHCH_2(C)$ and $(C)_2CHNHCH(C)_2$ (corrected for the interference corrections due to C—C—C and C—C—N) are found to be constant. From these the group parachor value for the group $(C)_2NH$ is deduced and the value of the interference correction for C—N—C is suggested.

94. Studies on Parachor. Part : VII.

A. M. TALATI, Petlad.

The atomic parachor for nitrogen has been calculated according to the Gibling's method. The values of the interference correction for the groups C—C—N, C—N—C, C—N—N, N—C—N and N—N—N are considered to be the same. The group parachor values for the groups $(C)NH(N)$, $(C)_2N(N)$ and $(C)N(N)_2$ are suggested and applied to the calculation of the parachor values of the compounds involving some of these groups.

95. Studies on Parachor. Part : VIII.

A. M. TALATI, Petlad.

Ring corrections for the five membered, six membered, seven membered and eight membered rings have been determined from the parachor values of cycloalkanes and are applied to the calculation of the parachor values of cycloalkenes and piperidine. A general equation is suggested for ring corrections and is utilised to show that the parachor value of a two membered ring is the same as that of a double bond.

96. Spectrophotometric studies on iron (III) morellin complex in Alcoholic medium.

S. G. TANDON and C. C. PATEL, Bangalore.

Spectrophotometric investigations carried out on mixtures of ferric chloride and morellin in absolute alcohol show that only one complex is formed, with an absorption maximum at $550m\mu$. Job's method of continuous variations indicates that $iron^{+3}$ and morellin combine in the molar ratio 2:3, yielding a complex of the formula Fe_2M_3 (M=morellin). The composition is also confirmed by the slope ratio method. The equilibrium constant K , determined spectrophotometrically is of the order of 5.0×10^{-17} for the dissociation of the complex in alcohol.

97. Charge and Stability of Colloids XX : Effect of non-electrolytes.

PARAMHANS TEWARI and A. C. CHATTERJI, Lucknow.

The influence of methyl, ethyl, n-propyl, n-butyl, n-amyl and n-hexyl alcohols on the coagulation of gold sol has been studied with barium chloride as coagulating electrolyte. It has been observed that except ethyl alcohol which sensitises the sol other alcohols produce stabilisation. It appears from the data that the

dielectric constant of the non-electrolytes which was attributed to be mainly responsible for sensitisation and protection is unable to explain the phenomenon.

98. Study of the Kinetics of Isotopic Exchange of Tris-Benzene-Azo-s-Naphthol Co (III) with Cobaltous Acetate in Pyridine and Quinoline.

K. S. VENKATESWARLU, AMAR NATH and JAGDISH SHANKAR, Bombay.

The half-time of exchange ($t_{1/2}$) in pyridine is found to be proportional to the reciprocal of the total concentration of the exchanging atoms (at a fixed temp.) and hence favour the "atom transfer" mechanism for the exchange.

The half-time of exchange in pyridine and quinoline, at $40 \pm 0.2^\circ\text{C}$, and at a concentration of 0.0025 M of each of the reactants, are 17 and 36 hours respectively. A marked "solvent effect" is apparent.

The activation energy in case of pyridine has been graphically determined as 10.7 k. cal./mole. The case of exchange seems to indicate that the bonds of the central cobalt atom in the complex, possess considerable 'ionic character'.

99. The Kinetics of increase in 'Retention' on heating, in Szilard-Chalmers reaction with Cobaltic Acetylacetonate.

K. S. VENKATESWARLU, AMAR NATH and JAGDISH SHANKAR, Bombay.

The complex was irradiated at a neutron flux of about $10^{10}\text{n/cm}^2/\text{sec}$. for 2 weeks at Bepo, Harwell. On heating for about 50 hrs., at about $83 \pm 0.5^\circ\text{C}$ and $94.5 \pm 0.5^\circ\text{C}$, showed an increase in 'retention' from 19.8% to 55.8% and 66.2% respectively. The kinetics of the increase in 'retention' was investigated and found to be of 'first-order'. The half-time for 'recombination', at the above-mentioned temperatures are 6 hrs. 12 mins. and 3 hrs. 24 mins. respectively.

The phenomenon may perhaps be pictured as follows: a large proportion of the recoil cobalt atoms lose their energy through the 'ligand skeleton', if the 'shielding' provided by the latter is reasonably sufficient, without irreparable damage to the 'ligand structure' and 'come to rest' at a site very close to the original.

R_∞ (viz. the saturation retention at any particular temp.) increases with temp.; perhaps an increase in temp. results in a fairly large change in amplitudes of vibration for certain atomic configurations of the 'ligand skeleton' resulting in a higher probability of recombination—the degree of the latter presumably depending on the nature of the 'ligand structure' in which the partially ejected cobalt atom finds itself.

100. Chain transfer in Benzoyl Peroxide Catalysed Polymerization of Styrene.

H. R. ZAIDI and TURNER ALFRAY JR., Hyderabad-Dn.

Chain transfer constants for the benzoyl peroxide catalyzed polymerization of styrene for five different solvents were determined. It was observed that the equation, $1/\bar{P} = 1/\bar{P}_0 + C(S)/(M)$, which has been derived by Mayo for the thermal polymerization of styrene holds true for the benzoyl peroxide polymerization also. Benzene acts as an inert solvent. Higher halogenated solvents have higher chain transfer activity. Carbon tetrabromide has the highest coefficient of chain transfer. The values followed the following order:



100A. Nature of Tannins in Terminalia Chebula.

B. M. DAS, S. K. BARAT and K. J. SCARIA, Madras.

The nature of tannins and their degradation products in Myrabolan nuts (*Terminalia chebula*) has been studied. Acetone extracted tannin has been fractionated and further purified by liquid/liquid extraction with ethyl acetate at different pH values. Molecular weights and degree of hydration of tanning in the fractions were determined by Cryoscopic methods and their buffer characteristics were studied from their titration curves obtained. Susceptibility of these fractional tannins to hydrolytic decomposition was investigated by observing the molecular weight and degree of hydration of the degraded products after prolonged boiling which was sufficient to induce hydrolysis. The findings have been correlated with the 'over all' tanning characteristics of Myrabolans with special reference to the mechanism of their penetration and fixation as well as the astringency of the material.

INORGANIC CHEMISTRY**101. Bipositive Silver Isonicotinate.**

BIRESWAR BANERJEE and PRIYADARANJAN RAY, Calcutta.

This paper describes a new bipositive silver complex with isonicotinic acid, which was prepared by the oxidation of silver (I) isonicotinate with sodium or potassium persulphate solution. The compound forms cinnamon red crystals. It is quite stable in dry atmosphere and at a fairly high temperature (110°-115°); liberates iodine from an acid solution of potassium iodide and chlorine from hydrochloric acid. It readily decomposes in dilute acids or alkalis. It gives a magnetic moment of $1.6\mu_B$, characteristic of bivalent silver.

The structure of silver (II) isonicotinate presents an intriguing problem. Formation of a metal chelate ring bridging the para positions is obviously improbable. It is, therefore, suggested that the crystal consists of either bimolecular aggregates, or of unending two dimensional sheets, giving rise to layer lattices. The structure of silver (II) nicotinate may also be represented in the same way.

102. Formation of Complex Compounds between Urea and Barium Halides. Part X. Transport Number Measurements.

M. P. BHATNAGAR and C. S. PANDE, Lucknow.

In previous communications, it has been shown that four definite complexes, (a) $BaX_2 \cdot CO(NH_2)_2$, (b) $BaX_2 \cdot 2CO(NH_2)_2$, (c) $BaX_2 \cdot 3CO(NH_2)_2$ and (4) $BaX_2 \cdot 4CO(NH_2)_2$ are produced in solution in the above systems. In order to obtain an additional confirmation and to have a more quantitative idea about the nature of these complexes, transport number measurements were carried out, which indicate: (1) no significant variation in the values of Ba ion in the presence of urea at a molecular ratio of (2:1), showing almost no tendency for the formation of the compound: $2BaX_2 \cdot CO(NH_2)_2$. (2) Different orders of magnitude in the values corresponding to other complexes assumed to exist in solution, proving the existence of such complexes and (3) almost the same variations in all the three systems at the same molecular ratios, indicating that the complexes found in all the systems are alike in nature.

103. Studies on the Co-ordination Complexes of Amino-acethydroxamic Acid.

AMIYA KUMAR CHAKRABURTTY, Calcutta.

Amino-acethydroxamic Acid or Glycine hydroxamic acid, $\text{NH}_2\cdot\text{CH}_2\text{C}(\text{OH})(:\text{NOH})$ has been found to act as a versatile bidentate chelating agent forming several types of co-ordination complexes with metals like copper (II), nickel (II), cobalt (III), iron (III), uranium (VI), chromium (III), manganese (III), vanadium (V) and molybdenum (VI).

In addition to the deep red-violet crystals of copper bis-glycinehydroxamate, $\text{Cu}(\text{C}_2\text{H}_5\text{O}_2\text{N}_2)_2\cdot 2\text{H}_2\text{O}$, a series of green copper mono-glycinehydroxamates of the type, $[\text{X}\cdot\text{Cu}(\text{C}_2\text{H}_5\text{O}_2\text{N}_2)\cdot\text{H}_2\text{O}]$, (where $\text{X}=\text{OH}$, Cl , Br , I , NO_3 , SCN , $1/2\text{SO}_4$ etc.), have been isolated. Some alkali and alkaline earth metal salts of the bis compound like $\text{M}'\text{H}[\text{Cu}(\text{C}_2\text{H}_4\text{O}_2\text{N}_2)_2]$ have also been obtained which include the dark-brown copper salt $\text{CuH}_2[\text{Cu}(\text{C}_2\text{H}_4\text{O}_2\text{N}_2)_2]_2$.

Nickel also forms similar types of compounds among which the diamagnetic bis compound $\text{Ni}(\text{C}_2\text{H}_5\text{O}_2\text{N}_2)_2$ (isolated in two different crystalline varieties, red and orange), the silky yellow mono-compound, $[\text{Ni}(\text{C}_2\text{H}_5\text{O}_2\text{N}_2)(\text{OH})\text{H}_2\text{O}]$, and the Na, K, Ca, Ba salts of the bis-variety have been isolated.

Cobalt (III) forms beautiful red crystals of cobaltic tris-glycinehydroxamate, $\text{Co}(\text{C}_2\text{H}_5\text{O}_2\text{N}_2)_3$.

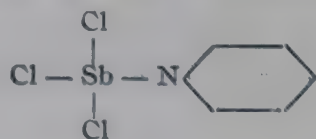
Two types of orange-yellow uranyl compounds have been isolated, one with two molecules of the ligand and the other with one.

The work of the isolation of the complexes of the ligand with Fe^{3+} , Cr^{3+} , Mn^{3+} , V^{5+} , and Mo^{6+} , and the use of the ligand as reagent for the colorimetric estimation of iron (III), vanadium and molybdenum are in progress. Various substituted amino-acethydroxamic acids and their higher and lower homologues are also being examined in this connection.

104. Trichloro-Pyridino-Antimony Complex.

R. DAS and S. PANI, Cuttack.

An ether solution of saturated aqueous antimony trichloride when mixed with ether solution of Pyridine yields a white substance containing three chlorine atoms and a pyridine molecule per atom of antimony. The compound is not hydrolysed easily in water. The Complex is represented by the following structure :

**105. Monofluo-arsenates and their Analogies with Sulphates.**

N. K. DUTT and A. K. GUPTA, Calcutta.

The following salts have been prepared and analysed— $\text{Na}_2\text{AsO}_3\text{F}$, $10\text{H}_2\text{O}$; $\text{K}_2\text{AsO}_3\text{F}$; CoAsO_3F , $6\text{H}_2\text{O}$; NiAsO_3F , $7\text{H}_2\text{O}$; CdAsO_3F , $8\frac{1}{3}\text{H}_2\text{O}$; CuAsO_3F , $5\text{H}_2\text{O}$; ZnAsO_3F , $7\text{H}_2\text{O}$; CaAsO_3F , $2\text{H}_2\text{O}$; BaAsO_3F ; PbAsO_3F . Double salts of the general formula $\text{K}_2\text{AsO}_3\text{F}$, MAsO_3F , $6\text{H}_2\text{O}$ where M is bivalent metal such as $\text{K}_2\text{AsO}_3\text{F}$, CoAsO_3F , $6\text{H}_2\text{O}$; $\text{K}_2\text{AsO}_3\text{F}$, NiAsO_3F , $6\text{H}_2\text{O}$ and K_2AsO_3 , ZnAsO_3F , $6\text{H}_2\text{O}$ have also been prepared by dissolving the two components together in minimum quantity of water in presence of dilute nitric acid and crystallising. In all the salts fluoarsenates resemble the sulphates in number of molecules of water of crystallisation, solubility etc.

106. Complex compounds of Cobalt (III) : Part—I. Dipyridino Cobaltic Bisbiguanidinium Hydroxide and its salts.

S. P. GHOSH and J. N. GUPTA, Patna.

Dipyridino cobaltic bisbiguanidinium complex has been prepared by the oxidation of cobaltous bisbiguanide in presence of pyridine. The dipyridino derivative was found to be more stable than the diamino derivative as it did not hydrolyse. The thiosulphate of this complex like that of the hydroxo-aquo derivative changed to μ -thiosulfato tetrakisbiguanide dithiosulphato dicobalt. From the complex oxalate the oxalato oxalate has been obtained. From the reactions studied the complex was found to have a *trans* configuration. A series of salts, viz. sulphate, nitrate, thiosulphate, iodide, chlorobromide as well as the hydrated base have been prepared and their properties studied.

107. Epitaxial Growth of Metals by Chemical Displacement.

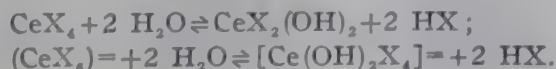
A. GOSWAMI, Poona.

The structures and the modes of growth of the electrodeposits have been extensively studied by the electron diffraction technique, but very little work has been done on the chemically displaced metal-deposits, especially in their initial stage of growth. In the present paper the structures of chemically displaced silver on the (110) and (100) faces of copper, and that of nickel and copper on the (100) face of iron single crystals have been studied by the electron diffraction technique. Silver was deposited from a complex cyanide bath, whereas nickel and copper were deposited from their sulphate solutions. It was observed that silver grew epitaxially with parallel orientation on the two faces of copper. On the (100) face of iron, nickel grew epitaxially but with (110) orientation, whilst copper deposits were randomly disposed on it. The latter, on the other hand, when electrolytically deposited from a complex cyanide bath, grew epitaxially. This difference in the behaviour of copper is ascribed to its electrode potential value in the two baths, the greater potential value resulting in randomly disposed deposits. With increase in thickness, the deposits may become random or one-degree orientated similar to that observed in cathodic deposits.

108. Studies in Ceric Salts.

R. N. KAPOOR, N. N. SHARMA and R. C. MEHROTRA, Lucknow.

A measurement of the pH of the following solutions, $\text{Ce}(\text{NO}_3)_4$, $\text{Ce}(\text{ClO}_4)_4$, $(\text{NH}_4)_2\text{Ce}(\text{NO}_3)_6$, and $\text{K}_2\text{Ce}(\text{NO}_3)_6$ indicates that these solutions are in general hydrolysed as below and that further hydrolysis is slow :



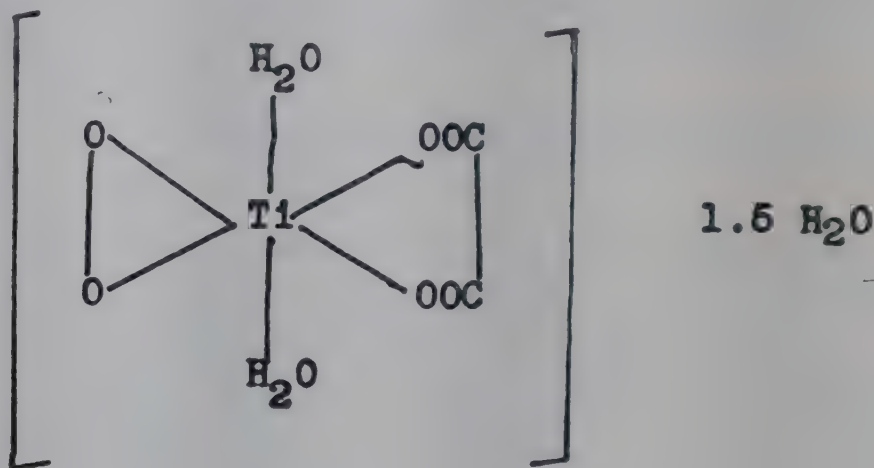
The above appears to indicate a similarity to zirconium salts which are known to give quite stable zirconyl ions in solution.

Electrometric titrations of solutions of ceric nitrate, potassium cerato nitrate and ammonium cerato nitrate with caustic alkalis have been carried out and almost identical curves have been obtained indicating that the cerato-nitric acid, $\text{H}_2\text{Ce}(\text{NO}_3)_6$, even if formed in solution, is a strong acid. However in all the above cases, precipitation begins when only three equivalents of the alkali have been added indicating the formation of basic salts similar to those found by Jones and Soper (1935) in ceratosulphate solutions.

109. Peroxy titanium Oxalate complex.

D. P. KHARKAR and C. C. PATEL, Bangalore.

When a suspension of freshly prepared pertitanic acid was mixed with oxalic acid in presence of hydrogen peroxide, a deep red solution was obtained, which on concentration at room temperature yielded a complex having the composition $\text{TiO}_2\text{C}_2\text{O}_4 \cdot 3.5\text{H}_2\text{O}$. Various physico-chemical studies like the vapour pressure measurements, absorption spectra, conductivity studies, thermogravimetric behaviour, and potentiometric titration indicate that the complex has the structural formula.

**110. Studies on the Carbonates of Transitional Elements.**R. M. MALLIA, D. S. BHARADWAJ and K. R. KRISHNASWAMI,
Bangalore.

The carbonates and bicarbonates of nickel and cobalt were prepared under various experimental conditions and were examined by different physico-chemical methods. Extent of dye absorption by the precipitates indicated that the surface properties differed although the chemical composition was practically identical in some cases. The thermogravimetric analysis of these compounds was carried out making use of the McBain-Bakr Quartz fibre spring. The thermo-analysis showed that these carbonates decompose at different stages beginning with 120°C . The decomposition will be complete at 350°C .

111. Reaction of the Alkoxides of Silicon, Titanium and Zirconium with Hydrogen Bromide.

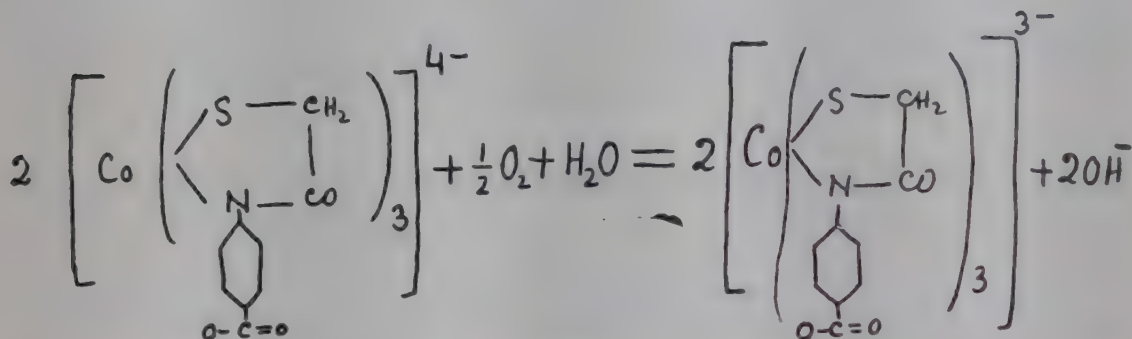
R. C. MEHROTRA, Lucknow.

It has been found that butyl orthosilicate does not react with hydrogen bromide, titanium alkoxides give di-bromide derivatives and zirconium isopropoxide gives a mixture of mono-isopropoxide tribromide and di-isopropoxide dibromide of zirconium. The reactions provide methods for the preparation of these new compounds and demonstrate an interesting gradation in properties from silicon to zirconium. An attempt has been made to explain this gradation in properties on the basis of electronic theory of chemical reactivity.

112. Complex of Trivalent Cobalt with p-(Mercaptoacetamido) Benzoic Acid.

R. N. MISRA and S. PANI, Cuttack.

Cobalt forms 1:3 complex with derivatives of thioglycollanilides (*Jour. Ind. Chem. Soc.*, 1955, **32**, 127). A mixture of cobalt sulphate with just excess of an alkali solution of p-(Mercaptoacetamido) benzoic acid is paramagnetic at the beginning but becomes diamagnetic after some time. Since cobalt hydroxide is not formed when the solution of the reagent containing excess of NaOH is added to cobalt sulphate it is assumed that cobaltous complex is first formed (which is paramagnetic) and is slowly oxidised to trivalent 6-co-ordination cobalt complex (which is diamagnetic). The reaction being,



The pH which is expected to rise due to the above reaction is also qualitatively observed.

113. Studies on hydrated ceric oxide. Part I. Preparation of normal ceric hydroxide.

S. S. MOOSATH, Trivandrum.

The oxidation product of cerous hydroxide with different oxidising agents has been variously described as, ceric hydroxide, hydrated ceric oxide, ceric-ceric oxide etc. No procedure has been described for obtaining the normal ceric hydroxide or the dihydrate of ceric oxide. A simple procedure has been developed for obtaining the same as a cream-coloured easy flowing powder. Dioxan and petroleum ether are used for getting this definite hydrate.

114. The Decomposition of Hyponitrites of Calcium and Strontium.

TRAMBAKLAL MOHANLAL OZA and VASANTRAI TRAMBAKLAL OZA,

Bombay.

The decomposition of SrN_2O_2 and CaN_2O_2 , H_2O (prepared) has been studied by (a) the application of heat and (b) exposure to carbon dioxide. The thermal decomposition products are found to be similar to those of SrN_2O_2 , $5\text{H}_2\text{O}$ and CaN_2O_2 , $4\text{H}_2\text{O}$, respectively. Carbon dioxide acts to different extents and moisture exercises an influence in the action. The results seem to show that reactions (1) $\text{RN}_2\text{O}_2 = \text{RO} + \text{N}_2\text{O}$ and (2) $\text{RN}_2\text{O}_2 = 2\text{RO} + \text{R}(\text{NO}_2)_2 + 2\text{N}_2$, which appear to be simultaneous, are the characteristic reactions of the decomposition. The possible resonance forms of hyponitrous acid are considered and an attempt is made to explain the formation of the observed decomposition products.

115. The Study of the Pyridine Complex of the Blue Peroxy chromic acid.

R. C. RAI and UTTAM CHAND, Agra.

The complex was prepared by adding ice-cooled Pyridine to an ethereal solution of Blue peroxy chromic acid till the violet blue colour of the perchromic acid was changed to greenish blue colour. The empirical formula was found to be $R Cr O_{2.5}$, where R stands for organic base. The complex was found to be insoluble in all organic as well as in inorganic solvents but dissolved in NaOH solution. When the pyridine complex is dissolved in NaOH solution, it gave in the beginning a reddish brown coloured solution which changed to greenish tinge and ultimately became yellow green. On boiling this solution, a greenish precipitate of $Cr(OH)_3$ was obtained indicating that chromium is present in the complex in the basic radical also. The amount of chromium in the basic radical was found to be just half of the total chromium. On the basis of this observation the molecular formula for pyridine complex is suggested as $R_2 Cr CR O_5$ or $R_4 Cr_2 Cr_2 O_{10}$.

116. The study of the Piperidine complex of the Peroxy-chromic acid.

R. C. RAI and UTTAM CHAND, Agra.

The Piperidine complex was prepared and studied as in the case of the pyridine complex. The molecular formula is suggested to be $R_3 Cr_2 O_5$ or $R_6 Cr_2 Cr_2 O_{10}$.

117. The oxidising power of chromium in relation to its probable composition.

RAM CHANDRA RAI and SATYA PRAKASH, Agra.

A large number of samples of blue chromium peroxide were prepared both from potassium dichromate and sulphuric acid and from chromic acid, varying the concentrations of hydrogen peroxide added. They were iodometrically titrated in two stages : (i) in absence of a mineral acid, and (ii) then in the acid medium. Their total available oxygen was compared with the oxygen available from their spontaneous decomposition product, which has been identified to have the composition of chromium dichromate. This ratio comes to be 2 : 1. These results show that the blue chromium peroxide has the composition of Cr_5O_{30} rather than CrO_5 as proposed by earlier workers. The intermediary reactions during the titration stages have been suggested.

118. Formation of Complex Compounds between potassium Chloride and Alkaline Earth Chlorides—Part IX.Systems :— $KCl-SrCl_2-H_2O$ and $KCl-BaCl_2-H_2O$.

L. N. SRIVASTAVA and P. C. BOSE, Lucknow.

Velocity of ultrasonic waves and adiabatic compressibility were determined for a series of mixed solutions of potassium chloride and strontium chloride, and potassium chloride and barium chloride prepared by the method of monovariation. The determination of velocity was carried out by the diffraction method. The distances between the lines of the same order were determined by a comparator, and the velocity was calculated. When the values of the velocity of ultrasonic waves were plotted against the concentration of strontium chloride and barium chloride four minima were obtained in the case of the system $KCl-SrCl_2-H_2O$ and seven minima were obtained in the case of the system $KCl-BaCl_2-H_2O$. These four

and seven minima corresponded to the four and seven complexes in the above two systems, the formulae of the complexes are given in the last para.

Adiabatic compressibility of the mixed solutions of potassium chloride and strontium chloride, and potassium chloride and barium chloride were calculated. When the values of adiabatic compressibility were plotted against the concentration of strontium chloride and barium chloride four and seven kinks were obtained on the curves of the two respective systems. These kinks are at places where the stoichiometric ratio between potassium chloride and strontium chloride are 3:2; 1:1; 3:4 and 2:3. In the case of the system $\text{KCl-BaCl}_2\text{-H}_2\text{O}$ the kinks are at places where the stoichiometric ratio between the two salts are 4:1; 3:1; 2:1; 3:2; 1:1; 2:3; and 1:2.

Thus in the case of the system $\text{KCl-SrCl}_2\text{-H}_2\text{O}$ the following four complexes are shown to exist in the aqueous mixed solutions:— 3KCl.2SrCl_2 ; KCl.SrCl_2 ; 3KCl.4SrCl_2 and 2KCl.3SrCl_2 . In the case of the system $\text{KCl-BaCl}_2\text{-H}_2\text{O}$ the following seven complexes are shown to exist in the aqueous state:— 4KCl.BaCl_2 ; 3KCl.BaCl_2 ; 2KCl.BaCl_2 ; 3KCl.2BaCl_2 ; KCl.BaCl_2 ; 2KCl.3BaCl_2 and KCl.2BaCl_2 .

119. Formation of Complex Compounds between Potassium Chloride and Alkaline Earth Chlorides—Part X.

System :— $\text{KCl-BaCl}_2\text{-H}_2\text{O}$.

L. N. SRIVASTAVA and P. C. BOSE, Lucknow.

The crystals that separated out in the mixed solutions of potassium chloride and barium chloride in which the stoichiometric ratio between the two salts is 2:1, were examined under the microscope and it was found that their shape did not resemble either with the crystals of potassium chloride or barium chloride.

The crystals were thoroughly washed and dried and their X-ray diffraction pattern was taken on the Phillips micro-diffraction unit using a tube with copper as an anticathode. The photograph was taken on a flat camera using ordinary Debye-Scherrer technique of powder photography.

The pattern gave five lines and the Bragg's spacing was calculated. On comparing the Bragg's spacing obtained for the complex with the known Bragg's spacing of potassium chloride and barium chloride (hydrated and anhydrous), it was found that two lines corresponded with the lines of $\text{BaCl}_2\cdot 2\text{H}_2\text{O}$, the third line corresponded with the line of potassium chloride and the fourth line resembled the corresponding line of anhydrous barium chloride. The fifth line does not correspond to any of the lines corresponding to that of potassium chloride or barium chloride and this line may, therefore, be attributed to the complex salt of the empirical formula K_2BaCl_4 .

120. Catalytic decomposition of potassium chlorate in presence of Oxides of Metals.

B. THAKUR and G. N. SINGH, Patna.

Manganese dioxide is used as a catalytic agent in the preparation of oxygen in the laboratory. It has been observed that oxygen prepared in this way is usually not pure. The gas contains varying amounts of chlorine. White fumes are also present in the gas. These fumes are not stopped by glass wool or water. The quantities of chlorine and white fumes depend upon the potassium chlorate-manganese dioxide ratio and the duration of heating. The quicker the reaction, more chlorine and white fumes are produced. The conditions for the production of maximum quantity of chlorine are under investigation. The chemical nature of the white fumes is also being studied.

121. Studies on the complexes of Phosphorus Oxychloride with Aluminium Trichloride.

K. N. VENKATARAMAN and K. R. KRISHNASWAMI, Bangalore.

The reaction between anhydrous aluminium chloride and phosphorus oxychloride has been investigated and the results indicate that these two compounds form a solid complex. During the chemical analysis of this compound, aluminium was estimated as the 8-hydroxy quinolate, phosphoric acid as the ammonium phosphomolybdate and chlorine by Volhard's method. Analytical results showed that the complex was of the formula $AlCl_3 \cdot 2POCl_3$. The compound consists of tiny white crystals which fume when exposed to air.

ORGANIC CHEMISTRY

122. Condensation of Urea with some Aromatic Aldehydes and Ammonia.

KHALIL AHMED and N. V. SUBBA RAO, Hyderabad (Dn.)

Past work on the condensation of urea with aliphatic aldehydes and ammonia or primary amines has been reviewed. Benzaldehyde, salicylaldehyde and anisaldehyde have now been successfully condensed with urea and ammonium acetate resulting in 1-Keto-3, 5, Diphenyl-Hexahydro-S-Triazine, silky white needles, M.P. 200; 1-Keto-3, 5-Di-(o-Hydroxyphenyl) Hexahydro-S-Triazine, yellow plates, M.P. 180° (with decomposition); 1-Keto-3, 5-Di-(p-Methoxyphenyl)-Hexahydro-S-Triazine, white silky needles, M.P. 182°C respectively.

123. Rauwolfia Alkaloids : Fractionation by Countercurrent Distribution.

R. P. BANERJEE, M. L. CHATTERJEE and H. F. HAUSLER, Calcutta.

The technique of countercurrent distribution permits the fractionation of a preparation of total alkaloids quantitatively into individual components with simultaneous assay of the preparation in respect of the distribution of the individual alkaloids contained therein.

Total soluble alkaloids from a Dehra Dun variety of *Rauwolfia serpentina* Benth. were partitioned into eight different pure alkaloidal fractions by employing the above technique. The alkaloids in the initial chloroform solution can be tentatively divided into three fractions, namely, (1) alkaloids obtained as salts in aqueous phase by repeated extraction of chloroform solution with 0.2M phosphate buffer pH 4.7; (2) those solubilised from the residual chloroform on similar treatment with 0.2 M phosphate solution pH 3.0; and (3) alkaloids which still remain in chloroform. Countercurrent distribution of material obtained from step (1) between chloroform and 0.2 M phosphate buffer pH 5.6 employing 40 transfers yields 2 clear alkaloid distribution peaks. Similar treatment of material solubilised by step (2) between chloroform and 0.2 M phosphate solution pH 3.6 results in the appearance of 4 alkaloid peaks. Material described as (3), on distribution between chloroform and 0.2 M phosphate solution pH 1.8, yields a further 2 pure fractions.

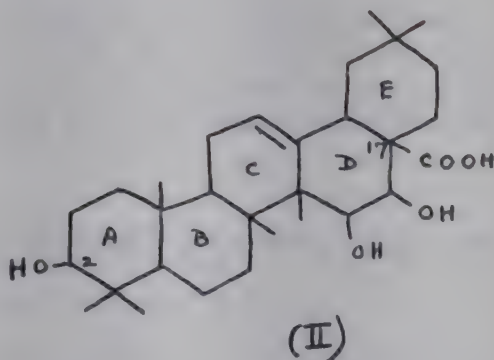
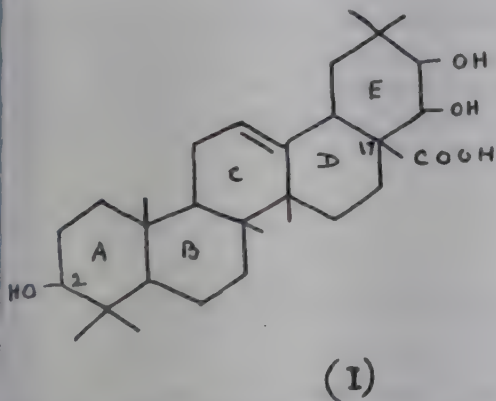
The relative proportions of the different alkaloids in the preparations can be assessed, as in paper electrophoresis, by measuring the area under the respective peaks in the alkaloid distribution curves.

124. The Constitution of Entagenic Acid—A New Triterpene Acid Sapogenin from the seeds of the Plant *Entada phaseoloides* Merrill.

A. K. BARUA, Calcutta.

Entagenic acid, $C_{60}H_{48}O_3$, m.p. 310-315 (decomp.) has been isolated from the seeds of the plant *E. phaseoloides* Merrill. It shows characteristic I.R. band at

2.7 μ -2.9 μ (for hydroxyl groups), at 5.9 μ (for carboxyl group) and at 7.22 μ (for C-Methyl groups). The methyl-ester, $C_{31}H_{50}O_5$, m.p. 243-245, on hydrolysis with alcoholic KOH gives back the original acid in poor yield. The rate of hydrolysis indicates that the carboxyl group is very hindered. Entagenic acid gives a triacetyl derivative, $C_{36}H_{54}O_8$, m.p. 188-189. Methyl entagenate forms a mono-tosyl derivative, $C_{36}H_{56}SO_7$, m.p. 151-152. Entagenic acid has got a hindered double bond. It forms a mono-bromo-lactone, $C_{30}H_{47}O_5Br$, m.p. 263-264, with bromine in acetic acid. I.R. spectrum shows characteristic γ -lactone band at 5.65 μ . The formation of the mono-bromo-lactone suggests that entagenic acid is similar to oleanolic acid and other triterpene acids of the α - and β -amyrin groups having a carboxyl group at C-17 and a double bond at 12:13 position. Since methyl entagenate in chloroform consumes nearly one mole of per-benzoic acid, entagenic acid appears to be a member of the β -amyrin group as members of the α -amyrin groups are inert to this reagent. One of the hydroxyl groups in entagenic acid may be assumed to be at C-2 in ring A as it is almost ubiquitous. Methyl entagenate forms an acetonyl derivative, $C_{34}H_{54}O_5$, m.p. 200-201. Methyl entagenate in methanol consumes one mole of per-iodic acid. These prove beyond doubt the presence of a single α -glycol system. The periodic acid oxidation product, $C_{31}H_{48}O_5$, m.p. 195, gives the tests for aldehyde. The failure to cyclise the periodic oxidation product to give an α - β -unsaturated aldehyde indicates that the α -glycol system is not in ring A. Methyl entagenate on oxidation with CrO_3 in acetic acid, gives a neutral triketone, $C_{31}H_{44}O_5$, m.p. 208. It does not give any colouration with ferric chloride and is deep yellow in colour which suggest it to be a true α -diketone. It gives a mono-2:4-dinitrophenyl hydrazone, $C_{37}H_{48}O_8N_4$, m.p. 225-226. Methyl entagentrione on hydrolysis with alcoholic KOH gives a decarboxylated product, Nor-entagentrione, $C_{29}H_{42}O_3$, m.p. 209-210. The above decarboxylation suggests that there is one ketonic group in methyl entagentrione which is β - to the carboxyl group. Nor-entagentrione gives colouration with ferric chloride which indicates it to be a diosphenol. (U.V. spectrum: γ max 283 m μ , ϵ 12,060.) From the above experiments it appears that most probably the α -glycol system in entagenic acid is either in ring D or E, assuming the carboxyl group to be in the usual position (C-17) and entagenic acid may be represented either as (I) or (II).



125. Antitubercular Compounds—Part IV.

A. S. BAVADEKAR, T. R. INGLE, R. V. GHATE, and B. V. BHIDE, Poona.

Recently Barry and co-workers [*Nature*, **156**, 48 (1945)]; [*Ibid*, **158**, 863 (1946); *Ibid*, **166**, 303 (1950)], have developed highly active succinic acids and allied compounds. The authors started with α -methyl, α' -dodecyl succinic acid and prepared a large number of derivatives on modifying the molecule. Barry's starting compound *viz.*



where $R = C_{12}H_{25}$



and $R' = CH_3$

is modified by replacing R & R' series of compounds having $R = C_6H_5.CH_2.CH_2$ and C_6H_5 and $R' = CH_3.H$ and $C_{10}H_{21}$ substituents are prepared. Following acids and their different derivatives like semianilides, amides, glycols and hydrazides etc. have been prepared.

(1) α -decyl, α' -(β phenylethyl) succinic acid ...	... M.P. 115°C.,
(2) α -methyl, α' -phenyl succinic acid ...	... M.P. 183°C., and
(3) Phenyl Succinic Acid ...	... M.P. 164-66°C.

The derivatives of the above acids are being tested against *Staph. aur* and *M. Tuberculosis*.

126. Studies on 3- β -Naphthyl-2- β -Naphthylimino-4-Thiazolidone.

P. N. BHARGAVA and Miss UMA BHATNAGAR, Banaras.

Bhargava synthesized a number of 3-aryl-2-arylimino-4-thiazolidones (*J. Amer. Chem. Soc.*, 1951, **73**, 2353). Klare, Markley, and Reid have studied the condensation of diphenyl thiourea, monochloroacetic acid and anhydrous sodium acetate in presence of ethanol. The authors, therefore, studied the rate of formation of this compound. *S*-di- β -Naphthyl-thiourea required for the reaction has been obtained according to Fry (*J. Amer. Chem. Soc.*, 1913, 1539) by using KOH or K_2CO_3 for the elimination of H_2S formed during the reaction. This on condensation with monochloroacetic acid and anhydrous sodium acetate with ethanol as solvent gave the required thiazolidone. On hydrolysis with acetic acid the thiazolidone gave the corresponding thiazolidione.

127. Condensation of Acetoacetic Ester with Aldehydes and Ammonia.

P. N. BHARGAVA and K. P. SINGH, Banaras.

In continuation to the earlier work on 4'-piperidones (Hantzsch and co-workers, *Ann.* 1882, **1**, 215; *ibid.* 155, 281; *Ber.*, 3, 399 *etc.*) a number of 2:6-diaryl-3-ethoxycarbonyl-4-piperidones have been synthesised, by condensing the corresponding aldehydes with acetoacetic ester and ammonia using glacial acetic acid as the solvent.

128. 2-p-Tolylimino-3-p-Tolyl-4-Thiazolidone.

P. N. BHARGAVA and B. CHITTYA, Banaras.

In continuation to the earlier work on 2-arylimino-3-aryl-4-thiazolidones (Bhargava, P. N., *J. Amer. Chem. Soc.*, 1951, **73**, 2353; Bhargava *et al.*, *J. Ind. Chem. Soc.*, 1955, **32**, 49), the present investigation has been extended to the synthesis of 2-p-tolylimino-3-p-tolyl-4-thiazolidone, the maximum yield of which has been obtained by employing an excess of monochloroacetic acid than the required molar quantity and refluxing the reaction mixture for 8 hours. The secondary formation of 3-p-tolyl-2:4-thiazolidione has been successfully suppressed by the addition of a sufficient quantity of anhydrous sodium acetate, which removes HCl *in situ*. Its condensation with ten aldehydes, one nitroso compound and two diazonium chlorides indicates the presence of an active methylene grouping. Oxidation with chromic anhydride in acetone or H_2O_2 in glacial acetic acid and acetic anhydride has resulted in the formation of 3-p-tolyl-2-p-tolylimino-4-thiazolidone-1-dioxide. All the above results establish the constitution of the compound.

129. Estimation of α -, β - & γ -Celluloses, Hemicelluloses A & B and Lignin.

PRITHWI NATH BHARGAVA, Banaras.

α -, β - and γ -Celluloses, hemicelluloses A and B and lignin have been estimated by the well known methods in twenty specimens of woods, shrubs and herbs. The original method of Schorger for estimation of lignin and those of O'Dwyer and Norris and Preece for estimation of hemicelluloses A and B have been modified. These modified procedures have been found better and more efficient.

130. Studies in Local Anaesthetics.

P. N. BHARGAVA and M. G. RAGHAVAN NAIR, Banaras.

Earlier workers have proved that the structural requirements for a local anaesthetic are a lipolytic end containing an aromatic nucleus, a hydrophylic end consisting a tertiary amino group and an intermediate alkyl or substituted alkyl chain. The compounds containing larger aromatic nucleus frequently possess greater activity than their benzene analogues (*Jour. Ind. Chem. Soc.*, 1954, **31**, 845; *Jour. Amer. Chem. Soc.*, 1948, **70**, 3474). Bjerregaard and Houston, Blicke and Parke (*Jour. Amer. Chem. Soc.*, 1939, **61**, 1200) and also Sargrevskaya and Neovabda (*Jour. Gen. Chem.*, U.S.S.R., 1938, **8**, 914) have reported active esters of aminonaphthoic acid.

The present work was undertaken with a view to synthesise piperidino, diethyl amino-, and carbazolo derivatives of chloracetyl-1-amino anthraquinone.

For the syntheses of these compounds, 1-amino anthraquinone was treated with chloracetyl chloride. The resulting chloro-compounds were condensed with the secondary bases.

131. Studies on 2-m-Tolylimino-3-m-Tolyl-4-Thiazolidone.

P. N. BHARGAVA and G. S. GOSWAMI, Banaras.

2-m-Tolylimino-3-m-tolyl-4-thiazolidone has been synthesised from *S*-di-*m*-tolylthiourea and monochloroacetic acid in the presence of anhydrous sodium acetate and absolute alcohol. *S*-di-*m*-tolylthiourea has been prepared from *m*-toluidine and carbon disulphide. During studies on the effect of reaction conditions on the preparation of the thiazolidone, the maximum yield is obtained by employing the amount of monochloroacetic acid slightly in excess than the required molar proportion and refluxing the reaction mixture for 4 hours. The thiazolidone decomposes quantitatively into *S*-di-*m*-tolylurea on boiling with alkali and into 3-m-tolyl-2:4-thiazolidone with hydrochloride acid. It has been condensed with a number of aldehydes, one nitroso compound and one diazonium chloride to give a series of the corresponding 5-substituted thiazolidones, thereby indicating the presence of an active methylene group at position 5. It also forms a hydrochloride and a picrate. Finally on oxidation with H_2O_2 in glacial acetic acid (Troutman and Long, *J. Amer. Chem. Soc.*, 1948, **70**, 3436), the thiazolidone is converted into sulphone. All the above results establish the constitution of the compound, which is supported by its synthesis.

132. Dichloro Phenyl Alkyl Sulphides and Sulphones : Part I.H. B. BHAT, S. M. DANDIN, P. B. SATTUR and K. S. NARGUND,
Dharwar.

Dichloro phenyl alkyl sulphides and sulphones have been prepared with a view to test them for fungicidal and insecticidal properties. Dichloro thiophenols were

obtained by (i) condensing diazotised 2:4 and 2:5 dichloro anilines with ethyl potassium xanthate and hydrolysing the mixture and (ii) Sulphonation of meta and ortho dichloro benzenes with chlorosulphonic acid and reducing the sulphonyl chlorides with zinc and sulphuric acid. The thiophenols were condensed with various alkyl iodides in presence of sodium ethoxide, to obtain the sulphides which were then oxidised to sulphones by hydrogen peroxide.

The following are described :—

2:5 dichloro phenyl	ethyl sulphide	b.p. 143/16mm. :	Sulphone M.P. 114.
" "	iso-propyl "	" 150/55mm. :	Sulphone " 123.
" "	butyl "	" 165/30mm. :	Sulphone " 68.
" "	amyl "	" 186/30mm. :	Sulphone b.p. 221/25mm.
" "	hexyl "	" 195/30mm. :	Sulphone " 242/55mm.
" "	benzyl "	M.P. 67 :	Sulphone M.P. 127.
" "	- β -hydroxy ethyl "	b.p. 205/35mm. :	Sulphone " 129.
2:4 dichloro phenyl	ethyl sulphide	b.p. 155/22mm. :	Sulphone b.p. 195/40mm.
" "	iso-propyl "	" 145/21mm. :	Sulphone M.P. 116.
" "	butyl "	" 168/25mm. :	Sulphone b.p. 203/20mm.
" "	amyl "	" 185/20mm. :	Sulphone " 210/25mm.
" "	hexyl "	" 178/35mm. :	Sulphone " 215/21mm.
" "	- β -hydroxy ethyl "	" 180/25mm. :	Sulphone " 230/25mm.
" "	benzyl "	" 210/35mm. :	Sulphone M.P. 98.

133. Sugar Constituents of Hemi-cellulose from arecanut husk by Paper Chromatography.

BHOLA NATH, Pabna.

The hydrolysate, prepared from mechanically decorticated arecanut husk in the usual way, has been examined chromatographically by the descending method through the parallel spotting of known sugars. The systems (a) phenol-NH₃ for 24 hours, and (b) n-butanol-acetic acid-water (4:1:5) for 72 hours were made use of, while aniline oxalate and naphthoresorcinol were employed as the spraying agents. The spots indicated the presence of rhamnose, xylose, arabinose, mannose, glucose and galactose.

134. On the Composition of the DDS By-product.

H. G. BISWAS, Calcutta.

The final mother liquor, a by-product obtained in the purification of the crude DDS by crystallization from rectified spirit has been found on exhaustive clinical trial to possess powerful therapeutic action against trophic ulcers in leprosy.

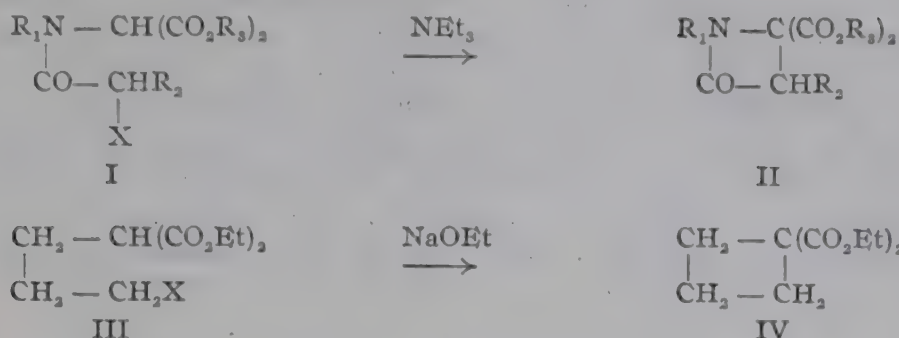
The mother liquor has been found to contain 60% rectified spirit and 40% total solid. On investigation three distinct compounds, 4:4'-diaminodiphenyl sulphone, 4-nitro-4'-aminodiphenyl sulphone and 2:4'-diaminodiphenyl sulphone have so far been identified in this solid. The ultimate mother liquor, a tarry viscous fluid solidified to a hard plastic like black mass.

135. The ease of formation of the Beta-lactam ring.

AJAY K. BOSE and B. N. MAZUMDAR, Kharagpur.

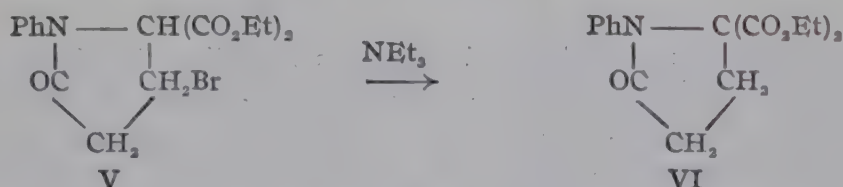
Under the influence of even a weak base like triethylamine, acetamidomalonic esters of type I are cyclized in nearly quantitative yield to beta-lactams of type II.

On the other hand, the ring closure of III to IV takes place in presence of an alkoxide but not of trimethylamine.



The cyclization of I involves the alkylation of an amidomalononic ester, that of III involves the alkylation of an alkylmalonic ester. We have, however, found that an amidomalononic ester like $\text{CH}_3\text{CONPhCH}(\text{CO}_2\text{Et})_2$ is not alkylated by an alkyl halide in the presence of triethylamine.

The halogen in I is adjacent to a carbonyl function; the enhanced activity of this halogen compared to the halogen in III could conceivably be the reason for the greater ease of cyclization of I. But, we have found that acetamidomalononic ester is not alkylated by ethyl bromoacetate in presence of triethylamine. Further, V in which the halogen is not adjacent to a carbonyl function, cyclizes (to a gamma-lactam VI) as easily as does I. We are therefore led to conclude that there is an inherent tendency for the formation of the beta lactam ring of type II just as there is an inherent tendency for the formation of six-membered and five-membered rings.



When a one step conversion of diethyl anilinomalonate VII to the beta-lactam II by interaction with chloroacetyl chloride and triethylamine was attempted, a crystalline halogen free compound, m.p. 184-185, was obtained. Some deep seated change seems to have occurred. The constitution of this compound is under investigation.

136. Stereochemistry of 3-p-menthane carboxylic acid and related compounds.

AJAY K. BOSE and R. SITA RAM IYER, Kharagpur.

Through Grignard reaction and carbonation menthyl chloride is converted to a crystalline menthane carboxylic acid, the configuration of which does not seem to have been determined. We subjected this acid to the stereospecific Schmidt reaction and obtained menthylamine in good yield. The amine was characterised by benzoylation and the amide did not depress the melting point of a genuine sample of the benzoyl derivative of (1)menthylamine. The carboxylic acid therefore has the carboxyl group at C_3 and is trans to the isopropyl group and is therefore equatorial in conformation. The Grignardisation *cum* carbonation has therefore led to the retention of configuration. This is in conformity with the observations that, cholesteryl chloride and cholestanyl chloride undergo carbonation with retention of configuration.

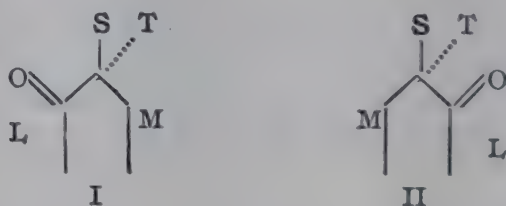
Shoppee has shown that the lithium aluminium hydride reduction of steroid oximes (C_3) affords the axial amino derivatives. Menthone oxime should therefore lead to neomenthylamine through lithium aluminium hydride reduction. We have not been able to reduce (-)menthone oxime even with a very large excess of lithium aluminium hydride under drastic conditions. This may indicate that the lithium aluminium hydride reduction of an oxime is susceptible to steric hindrance.

Following the recent work of Stevens, Morrow & Lawson an attempt was made to prepare pure neomenthyl chloride by the distillation of the imino ester hydrochloride from (-)menthol, and acetonitrile. The imino ester hydrochloride was readily formed in small yield. Distillation of this compound gave only traces of a halogen containing liquid.

137. Molecular Rotation and Absolute Configuration—Part II Ecgonine and its derivatives.

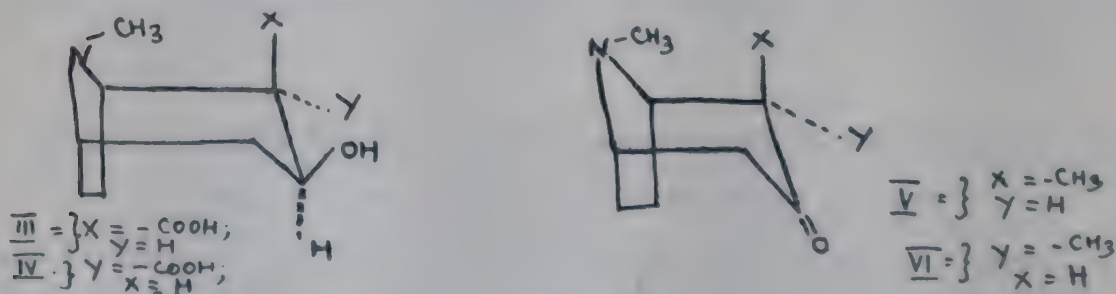
AJAY K. BOSE and N. VENKATESWARAN, Kharagpur.

In the case of a cyclohexanone derivative (I), the application of the rule enunciated in Part I, leads to the prediction that (I) would be more dextro rotatory than the epimer (II).



The generalisation of Stokes and Bergmann regarding the change in molecular rotation, due to the introduction of a keto group in steroids, conforms to this rule.

The usefulness of this rule may be illustrated by taking the case of ecgonine and pseudo-ecgonine, the configuration of which has been established by Fodor and co-workers, and by Findlay. By the application of reactions which proceed through the retention of configuration, (III) and (IV) have been converted to (V) and (VI) respectively and other derivatives.



The application of our rule to the ketones (V) and (VI) and other derivatives leads to the conclusion that the former should be more laevo-rotatory than the latter, if (V) and (VI) represent the absolute configuration of the ketones. Since (VI) has a $[\alpha] +6.15^\circ$ and (V) has $[\alpha] -25.5^\circ$, we conclude that (III) and (IV) represent the absolute configuration of ecgonine and pseudo-ecgonine respectively.

Very recently Hardegger has shown by oxidative degradation that ecgonine, is related to L (+) glutamic acid and its absolute configuration is therefore, represented by (III).

138. Studies on the seed fats of the Balsaminacea family, Part I : Oil from the seeds of *Impatiens balsamina*.

M. M. CHAKRABARTY, Calcutta and S. R. CHAKRABARTY, Coochbehar.

The oil from the seeds of *Impatiens balsamina* (Beng.—Dopati, Hindi—Gul-mandi, English—Garden Balsam) has been examined. The seeds yielded on extraction with light petrol 27% of yellowish oil having the following characteristics viz. :—

Sap. Equiv. ...	...	...	...	298.2
Iodine value (Wijs 30 min.)	...	...	...	177.4
Iodine value (Tom's)	...	...	...	237.3
Unsaponifiable matter %	...	...	...	0.9
Ref. Index at 35°C	...	...	...	1.5070
Free fatty acids % (as oleic)	...	...	...	0.5

The absorption spectra of the mixed fatty acids in alcoholic solution in unisomerised condition showed peaks at 234 m μ , 270 m μ , 291.5 m μ , 305 m μ and 320 m μ ; that at 305 m μ is the maximum, thus confirming the presence of parinaric acid (Δ 9, 11, 13, 15, octadecatetraenoic acid) which agrees with the results of Tutiya (*J. Chem. Soc. Japan*, 1940, **61**, 717, 867, 1188; 1941, **62**, 10, 552). Results on isomerisation indicate the presence of substantial proportions of linolenic and linoleic acids. Results of the analysis of mixed fatty acids have been reported.

139. Studies on the seed fats of the Balsaminaceae family, Part II : The component fatty acids of *Impatiens balsamina*.

M. M. CHAKRABARTY and S. SARKAR, Calcutta.

The component fatty acids of the seed fat from *Impatiens balsamina* have been investigated by recent methods of low-temperature crystallisation and ultra-violet absorption spectrophotometry. The mixed fatty acids were crystallised from a mixture of 5 times ether and 10 times light petroleum ether at -20°C first and subsequently from methyl alcohol at -45°C to yield three fractions which were separately analysed according to methods suggested by Riley (*J. Chem. Soc.*, January, 1950, pp. 12-18). The saturated acids from the most saturated fraction after the removal of unsaturated acids by Bertram's oxidation procedure was converted into methyl esters and fractionated. The percentage composition of the mixed fatty acids as computed from the data is—

parinaric (Δ —9, 11, 13, 15—Octadeca-tetraenoic) acid	29.14
linolenic acid	30.15
linoleic acid	9.17
oleic acid	18.30
saturated acids	13.24
	<hr/>
	100.00

The results agree fairly with those done earlier (*loc. cit.*) on the mixed fatty acids.

140. Studies on seed fat of the Leguminosae family : The component fatty acids of Albizzi lebbek seed fat.

M. M. CHAKRABARTY, Calcutta and ANUPAM SENGUPTA, Pilani.

In continuation of our previous work (Proc. 42nd Sci. Cong. Part III, Page 152), the component fatty acids from *A. lebbek* seed fat have been studied in greater

detail from another sample of fat obtained from last year's crop in Rajasthan. The mixed fatty acids (I.V. 120.0) were resolved by low temperature crystallisations from acetone and ether at -55°C and -20°C respectively to get three fractions—'A' (12.6% I.V. 37.2), B (55.8% I.V. 122.2) and C (31.6% I.V. 146.0). The fatty acids composition has been computed on the results of ultraviolet absorption spectrophotometry and methyl ester fractionation data. The % composition is linolenic 1.5, linoleic 58.4, oleic 9.6, saturated 30.5. The saturated fatty acids are composed of 6.21% myristic, 58.47% palmitic and 35.32% stearic. Higher fatty acids appear to be absent.

141. Paper Chromatographic Separation of some Natural Coumarins.

P. K. BOSE and D. P. CHAKRABORTY, Calcutta.

Paper chromatographic separation of some natural coumarins of Indian plants has been worked out using a wide variety of solvent systems. The coumarins were ayapin, bergapten, bykangelicin, coumarin, ferulin, limmetin, luvangetin, mormelosin, seselin, marmin, murrayin, pimpinellin. The R_f values have been determined mostly by observing the developed chromatogram under ultra-violet light. Attempts to separate the constituents from a mixture of the coumarins have been made. Water has been found to be the best solvent for the separation of the coumarins from the mixture. Coumarin has been detected on the developed paper under ultra-violet light in solvent systems pyridine-ammonia-water, formamide-ammonia-water, n-butanol-acetic acid-water. The relationship of their structures and behaviour in different solvent systems have been discussed. It has also been observed from the R_f values of coumarins in water as the solvent, that factors other than liquid partition are probably involved in the process.

142. Albusin, the Bitter Lactone of *Dictamnus Albus* Linn.

ASIMA CHATTERJEE and SUDHIR KUMAR SAHA, Calcutta.

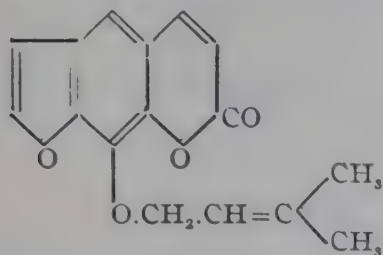
From the ether extract of white dittany root (*Dictamnus albus* Linn, Fam. Rutaceae) two bitter lactones, albusin, $\text{C}_{11}\text{H}_{22}\text{O}_5$, m.p. 224° , dec. (Yield, 0.3%) and albusinine, m.p. 271° , dec. (Yield, 0.05%) have been isolated. These bitter principles have been purified by fractional crystallisation and subsequently by chromatography over Brockmann alumina using chloroform as the solvent and methanol as the eluent. Albusin crystallises in rhombic plates from ethanol. It is sparingly soluble in chloroform, benzene, ethylacetate and acetone and insoluble in water. It contains a hydroxyl, a lactone and two side methyl groups. Quantitative detection of these functions in albusin have also been possible from the studies of its infrared spectrum (in chloroform). With tetranitromethane in chloroform it produces a yellow colouration indicating the presence of an unsaturation in the molecule of albusin.

143. Isolation of Allo-Imperatorin from *Aegle Marmelos* Correa.

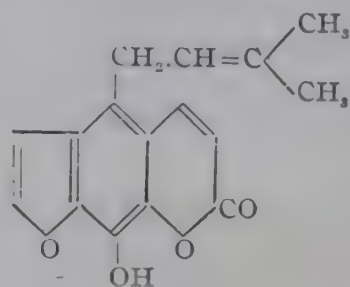
ASIMA CHATTERJEE and SUDHIR KUMAR SAHA, Calcutta.

Fruits of *Aegle marmelos* Correa (Fam. Rutaceae) are crushed in a wearing blender with ethylalcohol. The intimate mixture of fruit-pulp and alcohol thus obtained is filtered and the reddish brown filtrate is freed from alcohol and soxhletted with benzene. From this benzene extract a phenolic coumarin, $\text{C}_{15}\text{H}_{14}\text{O}_4$, m.p. $226-227^{\circ}$, dec. has been isolated. It produces a green colouration with an alcoholic solution of ferric chloride and upon methylation with diazomethane forms

a monomethyl ether, m.p. 113° . This coumarin has been proved to be identical with allo-imperatorin (I) from the study of its mixed m.p. and mixed chromatogram with an authentic sample of allo-imperatorin. Benzene mother liquor of allo-imperatorin upon chromatographic resolution over Brockmann alumina (using the same solvent as the eluent) furnishes imperatorin (II), $C_{16}H_{14}O_4$, m.p. 101° which upon thermal treatment isomerises to allo-imperatorin (I) by Claisen rearrangement.



(II)

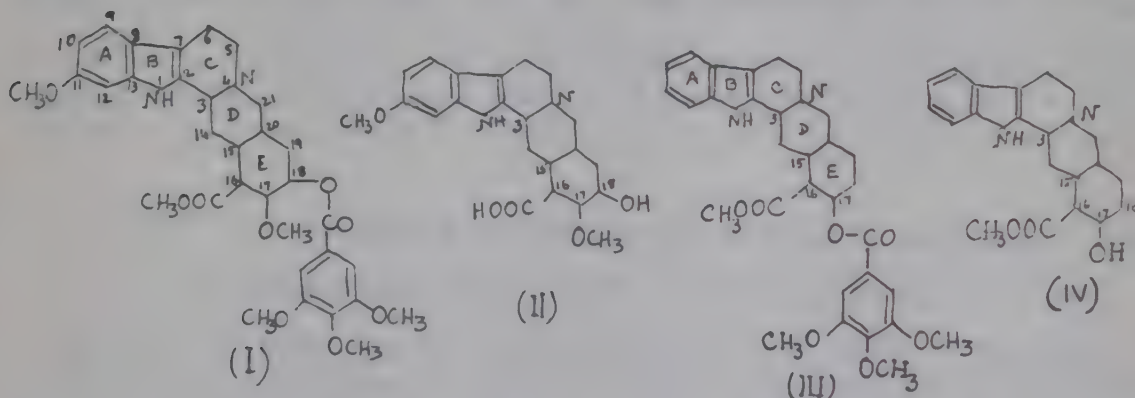


(I)

144. Structure-action Relation in Reserpine.

ASIMA CHATTERJEE and SUNIL KUMAR TALAPATRA, Calcutta.

The alkaloid, reserpine, $C_{33}H_{40}O_9N_2$, m.p. $264-65^{\circ}$, dec., (I) is one of the sedative and hypotensive principles of *Rauwolfia serpentina* Benth. The sedative



property of reserpine is lost when it is hydrolysed to reserpic acid (II), methyl alcohol and trimethylgallic acid from which it was thought that trimethoxybenzoyloxy moiety in ring E (I) potentiates the biological activity (hypnotic action) in reserpine. Now reserpine analogue (III) of rauwolschine (IV) i.e., trimethylgalloylrauwolschine has been synthesised, but it does not possess any reserpine like activity. It therefore, appears that either the stereochemistry of reserpine molecule or trimethoxybenzoyloxy group at carbon 18 plays the specific role in initiating the hypnotic action of the drug.

It has been established that reserpine has 3-epi- α -yohimbane structure at C_3 , C_{15} and C_{20} , its carbomethoxyl function at C_{16} being oriented equatorially. 3-Epi- α -yohimbine and its esters lack sedative properties from which it is concluded that trimethoxybenzoyloxy function at carbon 18 which has cis-configuration with respect to the carbomethoxyl group at C_{16} , potentiates the hypnotic action of reserpine.

145. An Alkaloidal Constituent of *Moringa Pterygosperma*.

R. N. CHAKRAVARTI, Calcutta.

Of the two alkaloidal bases, moringine and moringinine, isolated from the bark of *Moringa pterygosperma* (Hindi, *Shahjnah*; Beng., *Sajina*) by Ghosh, Chopra and

Dutt (*Indian J. Med. Res.*, 1935, **22**, 785), the former was found to be a liquid having the molecular formula C_7H_9N . The product was stated to be a derivative of pyridine or one closely allied to ephedrine.

Moringine has now been worked out properly and it has been found to be identical with benzylamine by direct comparison of the bases and their corresponding derivatives. The feeble optical rotation observed for moringine by the previous workers may be ruled out as experimental error since benzylamine does not contain any asymmetric carbon atom.

It is to be recorded as the first instance of identification of the presence of benzylamine in plants.

146. Composition of the Seed Fat of *Cucumis Melo*.

DIPTI KALYAN CHOWDHURY and RABINDRANATH BAGCHI, Calcutta.

Composition of the seed fat of *Cucumis Melo* (Bengali, *Kakur*), belonging to the *Cucurbitaceae* family has been determined by modern methods of spectrophotometric analysis. By extracting with petroleum ether (B.P. 40°-60°C.) 30.8% of oil on the weight of seed was obtained. The oil had a pale yellow colour with Refractive Index at 25°C, 1.4669, saponification value—176.4, saponification equivalent—318.6, Iodine value (Wij's 30 mins.)—117.6, unsaponified and unsaponifiable matters—1.2%, free fatty acids (as oleic)—1.1%. The component fatty acids had the following characteristics : saponification equivalent—303.1, Iodine value (Wij's 30 mins.)—124.0 $E \frac{1\%}{1\text{cm}}$ 180°C/60 minutes at 268 $m\mu$ —543. The component fatty acids were found to consist of 59.94% linoleic acid, 16.98% oleic acid, and 23.08% saturated acids. The industrial importance and possibilities of the oil have been indicated.

147. Composition of the Seed Fats of *Dolichos Lablab*.

DIPTI KALYAN CHOWDHURY and RABINDRANATH BAGCHI, Calcutta.

The seed fat composition of *Dolichos Lablab* (Bengali—*Makhan Shim*) has not hitherto been determined. The composition of the said seed fat has been determined in the present investigation by using the modern methods of ultraviolet absorption. The seeds having 20% shell and 80% kernel yielded only 0.95% of a light yellow coloured, odorless oil, on extraction with Petroleum Ether (B.P. 40°-60°C). The oil has a refractive index of 1.4675 at 25°C, Saponification value 154.7, Saponification equivalent 362.6, Iodine value (Wij's 30 mins.) 98.4, Unsaponifiable and Unsaponified matter 1.2%, free fatty acid (as oleic) 1.1%. The component fatty acids of the seed fat gave the following results on analysis :—Saponification equivalent—347.8, Iodine value (Wij's 30 mins.)—102.6 $E \frac{1\%}{1\text{cm}}$ 180°C/30 mins. at 234 $m\mu$ —226. The component fatty acids were found to consist of 0% Linolenic acid, 24.95% Linoleic acid, 24.31% oleic acid and 50.74% saturated acid. The fat is likely to contain high molecular weight saturated fatty acids that are uncommon in seed fats. Some uses of the seed fat have been indicated.

148. Composition of *Vigna Catjang* Seed Fat.

DIPTI KALYAN CHOWDHURY and RABINDRANATH BAGCHI, Calcutta.

The composition of hitherto uninvestigated *Vigna Catjang* (Bengali—*Barbat*) seed fat has been determined by modern methods of fat analysis in the present

investigation. *Vigna Catjang* seeds yielded 0.95% (on total seed) of a light yellow colored oil on extraction with petroleum ether. The oil has a refractive index of 1.4701 at 25°C, Saponification value—194.5, saponification equivalent—288.5, Iodine value (Wij's 30 mins.)—115.1, Unsaponifiable and unsaponified matter—1.2%, free fatty acid (as oleic)—0.9%. The mixed fatty acids of the oil have the following characteristics :—saponification equivalent—274.5, Iodine value (Wij's 30 mins.)—121.0, $E_{\frac{1\%}{1\text{ cm}}}$ unisomerised at 268 m μ -4 (neglected), $E_{\frac{1\%}{1\text{ cm}}}$ $\frac{170^\circ\text{C}}{15\text{ mins}}$ at 268 m μ -39, $E_{\frac{1\%}{1\text{ cm}}}$ $\frac{180^\circ\text{C}}{60\text{ mins}}$ at 234 m μ -378. The mixed fatty acids have the following composition, Linolenic 7.1%, linoleic 37.2%, oleic 37.8%, saturated 17.9%.

149. Sulphonamide Derivatives of Thiazoles.

BHASKAR DAS and M. K. ROUT, Cuttack.

In the present investigation, six different 2-acetylamino-thiazoles have been condensed with chlorosulphonic acid and the resulting 5-sulphonyl chloride derivatives have been converted into the corresponding 2-amino-5-sulphonamides and 5-substituted-sulphonamide. These compounds were prepared on account of their close structural similarity to sulphanilamide. These amino-thiazoles have also been condensed with acetyl-sulphanilyl chloride, p-fluoro-benzene-sulphonyl chloride and p-xylene sulphonyl chloride with a view to examine the effect produced by replacement of NH₂ group by F atom and alkyl group. Study of the usefulness of these compounds in combating bacterial infection is in progress.

150. Substitution Reactions of 2-Acetamidothiazole Compounds.

BHASKAR DAS and M. K. ROUT, Cuttack.

The substitution reactions of 2-acetamidothiazoles with mercuric chloride have been studied. By this reaction, chloromercuri group was introduced into the thiazole nucleus and evidence for the position taken up by it has been furnished. By cleavage of chloromercuri group, the resulting chloromercuri compounds have been converted into the corresponding 5-bromo, 5-iodo, 5-thiocyanato and 5-mercapto thiazoles.

151. A Note on the Colour Effects of Goran Liquor (*Ceriops Roxburghiana*).

B. M. DAS, S. K. BARAT and D. GHOSH, Madras.

The nature of colouring matter from Goran bark (*Ceriops Rexburghiana*) has been investigated with particular reference to their association with tannins. It is observed that the colouring matter exists as a tannin co-pigment and its source of production is traced to anthocyanidins and flavonols. It is probable that anthocyanidin, flavones and catechin occur together in Goran and being biogenetically related are interconvertible. Susceptibility of the colour to the changes in the acidity and salt content of the Goran infusion has been studied and means of eliminating some of the undesirable colour effects imparted by Goran tannage have been suggested. The darkening of the Goran tanned leather on exposure to light may be linked with the gradual conversion of Catechin to Catechitannic acid besides the probable development of a chromophoric group which is facilitated if the surface tannin is deposited in a comparatively acid medium.

151A. Studies on Thiosemicarbazones.

S. J. DAS GUPTA, Calcutta.

The author has found out a suitable commercial process for the manufacture of Thiacetazone. p-Nitrotoluene is simultaneously oxidised and reduced to p-amino-benzaldehyde by refluxing with sodium sulphide and sulphur in alkaline solution. The amino aldehyde is then acetylated with acetic anhydride in ether and finally condensed with thiosemicarbazide to give p-acetylaminobenzaldehyde thiosemicarbazone. Thiosemicarbazide is prepared by reacting hydrazine hydrate with potassium thiocyanate.

152. The colouring matters of the wood of *Artocarpus integrifolia*.

K. G. DAVE and K. VENKATARAMAN, Bombay.

Two new colouring matters, artocarpin and artocarpic acid, have been isolated from the heartwood of *Artocarpus integrifolia*, which contains morin and cyanomaclurin (A. G. Perkin, 1895). Analytical results for artocarpin and its derivatives and the molecular weight of the dimethyl and diethyl ethers by the X-ray method agree with the molecular formula $C_{26}H_{30}O_6$ or $C_{26}H_{28}O_6$. Magnesium-acid and sodium amalgam tests indicated γ -pyrone character. Artocarpin contains one methoxyl group and three phenolic hydroxyl groups, of which one cannot be methylated under the usual conditions. In the presence of palladium-charcoal artocarpin and the dimethyl ether absorbed one mol. of hydrogen in a few minutes and a second mol. in about 12 hours. Alkali fusion of artocarpin dimethyl ether gave 2-hydroxy-4-methoxybenzoic acid, acetic and isovaleric acid, and isoamyl alcohol. Oxidation of artocarpin dimethyl ether with permanganate gave isovaleric acid, 2:4-dimethoxybenzoic acid, and a chromone carboxylic acid which analysed for a hydroxytrimethoxy-C-methylflavone dicarboxylic acid. The results indicate that artocarpin is probably 5:2':4'-trihydroxy-7-methoxyflavone with alkenyl substituents in the 3- and 6-positions.

The constitution of cyanomaclurin has been re-examined. The chemical evidence is in agreement with the structure assigned by Appel and Robinson (1935), but the absorption spectrum is difficult to explain in terms of this structure.

153. Structure of Plant Gums : Chemical investigation of Sundra (*Acacia Sundra*) Gum.

PRASUN K. DHAR and S. MUKHERJEE, Kanpur.

The purified Sundra (*Acacia Sundra*) Gum was non-reducing and possessed an equivalent 1080. The purified gum on autohydrolysis gave arabinose and rhamnose and a trace of galactose and a degraded gum. The barium salt of the degraded gum on further hydrolysis with 0.1 NH_2SO_4 on boiling water bath gave mainly galactose and a trace of arabinose and aldobiouronic acid, isolated as Ba-Salt Ba 16.8 per cent. (ba-aldo biourenate requires Ba=16.2 per cent). The aldobiouronate on further hydrolysis with NH_2SO_4 gave galactose and a degraded aldobiouronic acid isolated as Barium-Salt (Ba % 21.35). Further work on the structure of the aldobiouronic acid is in progress.

154. Structure of jeol (*Odina Wodier*) Gum : The nature of the component sugars and the structure of the aldobiouronic acid.

PRASUN. K. DHAR and S. MUKHERJEE, Kanpur.

The gum (*Odina Wodier*, *Rexbergii*) was obtained from the district of 24 Parganas, West Bengal in the form of brown nodules. It was purified first by dissolving in N/10 Caustic Soda and filtering and acidifying with glacial acetic acid and pouring in large quantity of alcohol with continuous stirring. The precipitated

gum was again dissolved in water, acidified with hydrochloric acid and reprecipitated with alcohol. The purified gum is soluble in water and caustic soda solution forming a yellowish brown opalescent solution. The gum did not give an insoluble copper salt and did not reduce Fehlings solution. (Sulphated ash 5%, Nitrogen, and Sulphur absent, Pentosans 32.9 per cent, Pentoses calculated on the basis of pentosans 37.5 per cent furfural 19.3 per cent equivalent weight 720). The gum on oxidation with nitric acid (d 1.15) gave mucic acid, in the yield equivalent to the presence of at least 18.5 per cent galactose. On autohydrolysis arabinose residues are split off. Arabinose was obtained in shining crystals, M.P. 155-6° (undepressed when mixed with an authentic specimen). It gave diphenylhydrazone M.P. 194°, and p-nitrophenyl hydrazone-M.P. 180°-181°. The Barium salt of the residue was further hydrolysed by boiling with 0.1 NH_2SO_4 , when D. galactose and an aldobiouronic acid were obtained, mixed with small amount of arabinose-D-galactose was indentified in the hydrolysed solution both as crystalline sugar M.P. 165-166° $[\alpha] + 81.8^\circ$ and as methylphenylhydrazone, M.P. 180-182°. Barium salt of the aldobiouronic had barium 16.3% (calculated value 16.2%). The Barium salt of the aldobiouronic acid on further hydrolysis with $2\text{NH}_2\text{SO}_4$ yielded galactose and Uronic acid, which was isolated as its barium salt (Found Ba=28.9%, cal. for Barium Hexuronate, Ba=26.2%). The uronic acid was identified as galacturonic acid by Ehrlich's test. The Ba salt of the aldobiouronic acid was oxidised with sodium meta periodate and from the reaction mixture formaldehyde was isolated in the form of crystalline dimedone derivative, M.P. 186-187°. The production of the formaldehyde by periodate oxidation suggests that there is no 1-6 linkage in the acid.

The Barium salt of aldobiouronic acid was methylated thrice with dimethyl sulphate and sodium hydroxide (40%) and thrice by methyl iodide and Silver oxide—The completely methylated product was distilled and fraction distilling between 160-210°C (bath temp.)/0.5 m; contained the completely methylated aldobiouronic acid (Found OMe 52.3%, Cal. OMe 52.99%). The completely methylated aldobiouronic was hydrolysed first with Methanolic hydrogen chloride and then with N-HCl to give two fractions. The first fraction was identified as 2:4:6 Trimethyl galactose it gave an anilide M.P. 181°C. Work is in progress to identify the galacturonic acid, but it is assumed to be 2:3:4 Trimethyl-galacturonic acid. Therefore assuming the acid part as galacturonic acid, the structure of the aldobiouronic acid may be stated as 3 (D-galacturonopy ranosyl)-D-galactopyranose.

155. Synthesis of Cyanine Dyes by Condensation of p-Diethylaminobenzaldehyde with Heterocyclic Compounds : Part VII.

M. Q. DOJA and J. C. BANERJI, Patna.

Six new cyanine dyes have been prepared by condensing p-diethylaminobenzaldehyde with the methiodides of 4-p-tolyl-, 4-p-chlorophenyl-, 4-p-bromophenyl-, 4-p-iodophenyl-, 4-phenyl-5-methyl-, 4:5-diphenyl-2-methylthiazole respectively and their optical and other properties examined. Results of previous communications have been collated and it has been pointed out that with regards to the extra sensitization conferred, substitution at the 5-position of the thiazole nucleus is more effective than that at the 4-position while the substituents at the 4-position fall in the order (p) $\text{I.C}_6\text{H}_4\text{-}$ (p) $\text{Br.C}_6\text{H}_4\text{-}$ (p) $\text{Cl.C}_6\text{H}_4\text{-}$ (p) $\text{CH}_3\text{.C}_6\text{H}_5\text{-}$ $\text{C}_6\text{H}_5\text{-}$ $\text{CH}_3\text{-}$. An alternative mechanism for the reaction involved in the synthesis of the dyes has been proposed.

156. Chemical investigation of Plant insecticides-Isolation of active principle from the root bark of *Mundulea suberosa* Benth.

N. L. DUTTA, Poona.

Three crystalline compounds (i) m.p. 216-17°, (ii) m.p. 192° and (iii) m.p. 74-75° have been isolated from the ether extract of the root bark of *Mundulea suberosa*.

The substance m.p. 192° which is the main component (provisionally named as Munetone) is soluble in benzene, chloroform, ether, acetone and ethyl acetate and sparingly soluble in methyl and ethyl alcohols. It corresponds to a molecular formula $C_{21}H_{20}O_4$, contains one methoxyl group, is optically inactive and does not give any colouration with ferric chloride. It gives negative Dusham's test for rotenoids. It gives an oxime m.p. $214-15^{\circ}$ but does not form any derivative with 2:4-dinitrophenyl hydrazine. It easily gives a bromo derivative, m.p. $207^{\circ}C$. On hydrolysis with alcoholic potash (3-20%) Munetone produces a compound m.p. 128° , which gives intense colouration with ferric chloride and gives an oxime m.p. $224-25^{\circ}$. Neither Munetone nor the product obtained on hydrolysis, could be hydrogenated with PtO_2 catalyst.

Work on the constitution of the substance is in progress.

157. On the synthesis of Δ^1 -Pyrroline Derivatives : Part II.

T. N. GHOSH, Calcutta.

In contrast with the usual formation of Guareschi imides when ketones are reacted in presence of ammonia with ethyl cyanacetate or its amide, an α -acetamidoketone, under similar condition, has been found to furnish a compound, in which the presence of a free amino, a cyano and a carboxamido groups was established. The compound could be best formulated as a Δ^1 -pyrroline derivative, and the mechanism suggested for its production is based on the initial formation of a carbinol-amine which then reacts with cyanacetamide (cf. Robinson, *J. Chem. Soc.*, 1917, **111**, 876) and the resulting intermediate readily cyclises, under the experimental condition, to form the pyrroline derivative. For example, (α -acetamido- β -*o*-chlorophenyl)-ethylmethyl ketone, when treated with ethyl cyanacetate or cyanacetamide in presence of ammonia, furnishes 2:4-dimethyl-3-cyano-3-carboxamido-4-amino-5-*o*-chlorobenzyl- Δ^1 -pyrroline.

The general applicability of the above reaction has been studied with various α -acetamidoketones, the availability of which has been rendered possible in recent years by the general application of the Dakin and West reaction (*J. Biol. Chem.*, 1928, **78**, 91, 745, 757). For instance, (γ -methylmercapto- α -acetamido)-propylmethyl ketone could be easily obtained by subjecting methionine to Dakin and West reaction with acetic anhydride in presence of pyridine.

158. Synthesis of 4:5-substituted Coumarones.

K. G. GORE and M. G. MARATHEY, Poona.

The synthesis of 4:5-substituted coumarones has been undertaken to obtain β -diketone derivatives containing a furane ring, thus obtaining compounds structurally similar to Pongamol which has been recently shown to be a β -diketone derivative.

4-Methyl-5-hydroxy-6-acetyl-coumarin, m.p. 165° , I on bromination with one molecule of bromine in acetic acid gave two isomeric 4-methyl-5-hydroxy-6-acetyl-3-bromocoumarins, m.p. 226° , II, and m.p. 167° , III. Both the bromocoumarins II, and III, on treatment with sodium carbonate gave identical 3-methyl-4-hydroxy-5-acetyl coumarone, m.p. 80° , IV. (Reported m.p. 70°).

4-Methyl-5-hydroxy-6-acetyl-3:8-dibromo-coumarin, m.p. 174° , VI, which could not be obtained by bromination of 4-methyl-5-hydroxy-6-acetyl-coumarin, m.p. 165° , I, with two molecules of bromine, was obtained by brominating 4-methyl-5-hydroxy-6-acetyl-8-bromo coumarin V, with one molecule of bromine. VI on hydrolysis with sodium carbonate gave 3-methyl-4-hydroxy-5-acetyl-7-bromo-coumarin, m.p. 108° , VII.

159. Synthesis of β -Diketones.

K. G. GORE and M. G. MARATHEY, Poona.

In order to compare the physical properties such as absorption spectra, fluorescence, dipole moments of compounds, structurally similar to Pongamol following β -diketones have been synthesised.

2'-Hydroxychalkone dibromide, I, on controlled hydrolysis with sodium hydroxide gave 2'-hydroxy-dibenzoylmethane, II. 2'-Hydroxy-5'-methyl-chalkone dibromide, III, on controlled hydrolysis with sodium hydroxide gave 2'-hydroxy-5'-methyl-dibenzoylmethane, m.p. 170°, IV. 3-Methyl-5-ethyl-6-hydroxy-7-acetyl-coumarone, m.p. 64°, V, on condensation with ethyl benzoate in the presence of sodium gave 2'-hydroxy-3'-ethyl-5'-6'-6'-(3''-methyl-furano)-dibenzoyl-methane, m.p. 122°, VI. This compound may be called as a derivative of iso-pongamol.

If the alkali hydrolysis of chalkone dibromides is not controlled the reaction goes further, e.g. instead of 2'-hydroxy-dibenzoyl methane, acid and ketone splitting takes place to give orthohydroxy acetophenone and benzoic acid; salicylic acid and acetophenone.

160. Oil of Carrot Seed.

J. C. GUPTA, G. N. GUPTA and D. R. DHINGRA, Kanpur.

Carrot called *Daucus Carota* L. is commonly cultivated in India for culinary purposes. Its seed contains both fixed and essential oils. The latter is used for flavoring all kinds of food substitutes and also in perfumery. As no work has been done in India on essential oil from carrot seed, therefore this work was taken up. The physico-chemical constants of the oil are as follows :—

Sp. Gr. at 20°C-0.9554; Ref. Index at 20°C-1.4954; Opt. Rot.—+17.60°; A.V. 1.6; E.V. 13.09; E.V. after acetylation 50.51; Solubility—Soluble in 5.5 Vol. of 90% alcohol.

The chemical composition of the oil is under examination.

161. Oil of Fennel Herb.

J. N. GUPTA and G. N. GUPTA, Kanpur.

There are about a dozen varieties of Fennel, which differ in odour and flavour. Bitter and the sweet Fennels are the two main varieties. The former variety grows wild as well as cultivated while the latter variety is cultivated.

Fennel seeds are widely employed in culinary preparations for flavouring bread and alcoholic liquors and also in medical preparations.

As no work on the India Fennel herb and seed oils has been done so far, therefore this work was taken up. The herb and seed oils had the following properties :—

Herb Oil :—

Specific Gr. at 20°C.	...	...	...	...	0.8932
Ref. Index. at 20°C.	...	...	...	...	1.502
Optical Rot.	...	...	...	...	+ 52.8
Acid Value	...	...	...	...	0.273
Ester Value	...	...	...	...	27.64
Ester Value after Acetylation	...	...	...	...	39.63
Percentage of Aldehydes and Ketones	...	...	...	...	= 65%
Solubility in 90% Alcohol	...	...	...	...	= 1 : 1 Alc.
Solubility in 90% Alcohol	...	...	...	...	= 1 : 1 Alc.

The oil contains Phellandrene, Fenchyl Alcohol, Fenchone, Methyl Chavicol and Anethole.

Seed Oil :—

Specific Gr. at 20°C.	...	...	...	...	0.9682
Ref. Index. at 20°C.	...	...	...	...	1.5487
Optical Rot.	...	...	...	...	+ 4.8
Acid Value	...	...	...	...	0.14
Ester Value	...	...	...	...	9.94
Ester Value after Acetylation	...	...	...	...	18.09
Congeaing Point	...	...	...	...	+ 11.5
Anethole Percentage	...	...	...	...	80%

The detailed chemical analysis of the oils is in progress.

162. Essential Oil from the Rhizomes of *Acorus Calamus*, Linn.

J. C. GUPTA, G. N. GUPTA and D. R. DHINGRA, Kanpur.

Acorus calamus L. (Fam. Araceae) known in Hindi as *bach* is a semi-aquatic perennial growing wild in damp, marshy places. It is indigenous to India and Burma. The dried rhizomes are employed in medicinal preparations and for the flavoring of liquors. Its oil possesses superior germicidal properties and is also employed in perfumery. It has a peculiar spicy odor and blends well in composition of the heavier oriental type.

The rhizomes of *Acorus calamus* L. were purchased from the local market and distilled. The essential oil (yield 5.1 per cent) so obtained was examined. The physico-chemical constants of the oil are as follows :—

Sp. gr. at 30°C—1.0784; Ref. Index at 30°C—1.5489; Opt. Rot.—+4.2°; A.V.—2.08; E.V. 5.90. E.V. after acetylation—15.45; Methoxy content—35.8%.

The oil consisted mainly of asarone 80.1% along with calamene, eugenol-methyl-ether, calamenenol, palmitic and other fatty acids, etc.

163. Preparation of Essences.

J. N. GUPTA and G. N. GUPTA, Kanpur.

The essences are extensively used in the preparation of aerated and perfumed waters, syrups, confectionary, ice cream etc., but most of them are imported from outside.

Two types of essences are generally made in water e.g. (1) made with the help of alcohol (2) free from alcohol. These essences contain 2-4% essential oil.

Some emulsifiers were imported from U.S.A. and U.K. and were used in the preparation of essences. Two emulsifiers namely Tween 20, and G. 2162 were found satisfactory. None of the samples including 'Diolane' from U.K. proved successful.

The essences prepared were of rose, lemon, orange, khus, kewda, Raspberry etc.

164. Studies in Unsaponifiable matter in Vegetable Oilseeds.

S. K. K. JATKAR and (Miss) M. V. NATEKAR, Poona.

A new compound has been worked up here from the unsaponifiable matter of sesame or til oil (*Sesamum indicum*). Two varieties, viz. Red and White show different contents of the same new substance as observed from the absorption spectra of the two oils in spectrophotometrically pure alcohol on a Beckman D.U. Spectro-

photometer. The compound was isolated from an alcohol extract of the oil, and had a m.p. of 120°C. Analytical data has been studied. Absorption of the same compound shows maxima at 240 and 286 m μ and minima at 220 and 260 m μ . The compound in alcoholic solution gives bluish green fluorescence in ultraviolet light. It seems that it is analogous to the class of sesamin, sesamol, sesamalin, etc. It is not, however, responsible for the colour in the Baudoin test. The structure is under investigation.

164A. Hydroxy-ketones, Part VI—Synthetic Bactericides through Fries rearrangement and Wolff-Kishner's Reduction.

V. P. MALIK and G. S. SAHARIA, Delhi.

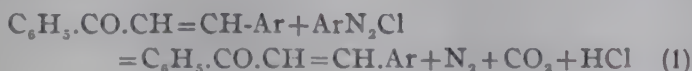
Following the considerable interest which centres round the preparation of synthetic bactericides and the interesting results obtained by Klarmann on phenolic bactericides of the diphenyl methane series, we have prepared compounds of similar type.

Phenols, isomeric cresols and naphthols were condensed with p-chlorobenzoyl chloride and the esters thus obtained were subjected to Fries migration; the ketones were then reduced by Wolff-Kishner's method and the required compounds obtained.

164B. The coupling of β -4-methoxy-, and β -3:4-dimethoxy benzoyl acrylic acids with aryl diazonium chlorides.

H. S. MEHRA and K. B. L. MATHUR, Delhi.

It has been previously shown that aryl diazonium chlorides having negative substituents couple with β -benzoyl acrylic acid under Meerwein's conditions to give chalkones, thus,



A similar study has now been made with respect to β -4-methoxy and β -3:4-dimethoxy benzoyl acrylic acids. Coupling occurs in a way analogous to that in React. (1), the product being 4'-methoxy-, and 3':4'-dimethoxy chalkones. The latter have been recovered by extraction of the complex reaction products with aq. KHSO₃ or H₂SO₄ (80-85 per cent.). From β -4-methoxy benzoyl acrylic acid are obtained (yield and formula of the diazotised base reacted are shown in parenthesis) the following chalkones: 4'-methoxy-(I), m.p. 106° (7, C₆H₅N₂Cl), 4-chloro 4'-methoxy-(II), m.p. 130° (13.3, p-Cl.C₆H₄N₂Cl), 3-chloro 4'-methoxy-(III), m.p. 119° (5, m-Cl.C₆H₄N₂Cl), 2-chloro 4'-methoxy-(IV), m.p. 92° (12.4, o-Cl.C₆H₄N₂Cl), 4-bromo 4'-methoxy-(V), m.p. 153° (10.3, p-Br.C₆H₄N₂Cl), 4-nitro 4'-methoxy-(VI), m.p. 168° (22.6, p-NO₂.C₆H₄N₂Cl), 3-nitro 4'-methoxy-(VII), m.p. 153° (10.3, m-NO₂.C₆H₄N₂Cl), 2-nitro 4'-methoxy-(VIII), m.p. 111° (8.4, o-NO₂.C₆H₄N₂Cl). From 3:4'-dimethoxy benzoyl acrylic acid are obtained: 3':4'-dimethoxy-(IX), m.p. 84° (8.1, C₆H₅N₂Cl), 4-nitro 3':4'-dimethoxy-(X), m.p. 178° (21.2, p-NO₂.C₆H₄N₂Cl), 3-nitro-3':4'-dimethoxy-(XI), m.p. 126° (23.1, m-NO₂.C₆H₄N₂Cl). M.P. of chalkones (VI-VIII) and (IX-XI) remained undepressed when mixed with authentic samples. It is, however, significant to note that even benzene diazonium chloride, which is less reactive, could couple to give the chalkones (I) and (IX). In the light of latter observation and considering the yields of the chalkone generally, it is inferred that 4-methoxy-, and 3:4-dimethoxy benzoyl acrylic acids undergo the Meerwein's reaction better than the parent acid.

165. High pressure catalytic ammonolysis of alcohols.

V. A. KRISHNA MURTHY and M. R. A. RAO, Bangalore.

The reactions between aliphatic alcohols and ammonia have been investigated under the optimum conditions, obtained for the ammonolysis of butyl alcohol. At a temperature of 300°C. and a pressure of about 300 psig, 24 to 38 per cent. conversion of ethyl, propyl, butyl, amyl, and hexyl alcohols to amines has been achieved when alumina, prepared from aluminium nitrate, was employed as the catalyst. From similar studies with olefins, it is concluded that the reaction takes place by the combined dehydration of alcohol and ammonia and not by the intermediate olefin formation as was suggested by some previous workers.

166. Dichloro Phenyl Alkyl Sulphides and Sulphones : Part II.G. H. KULKARNI, H. S. IYENGAR, P. B. SATTUR and K. S. NARGUND,
Dharwar.

In continuation of the work described in Part I, the following 3:4 and 3:5 dichloro phenyl alkyl sulphides and sulphones have been prepared. 3:4 and 3:5 dichloro thiophenols were prepared by condensing diazotised 3:4 and 3:5 dichloro anilines with ethyl potassium xanthate and hydrolysing the reaction mixture. These thiophenols were condensed with various alkyl iodides to obtain dichloro phenyl-alkyl sulphides, which were then oxidised by hydrogen peroxide.

The following are described :—

3 : 4 dichloro phenyl	methyl sulphide	b.p.	145/20 mm. : Sulphone M.P. 108.
" "	ethyl	" "	160/25 mm. : Sulphone M.P. 88-89.
" "	isopropyl	" "	145/20 mm. : Sulphone b.p. 228/35 mm.
" "	butyl	" "	175/25 mm. : Sulphone M.P. 56-7.
" "	amyl	" "	190/25 mm. : Sulphone b.p. 240/26 mm.
" "	hexyl	" "	200/25 mm. : Sulphone b.p. 260/35 mm.
" "	benzyl	" "	215/25 mm. : Sulphone M.P. 143.
" "	-β-hydroxy ethyl	" "	205/20 mm. : Sulphone b.p. 230/20 mm.
" "	Cyclo hexyl	" "	205/35 mm. : Sulphone b.p. 205/20 mm.
3 : 5	methyl	" "	140/20 mm. : Sulphone M.P. 116.
" "	ethyl	" "	145/25 mm. : Sulphone M.P. 153.
" "	isopropyl	" "	150/20 mm. : Sulphone b.p. 200/25 mm.
" "	butyl	" "	165/20 mm. : Sulphone b.p. 220/35 mm.
" "	amyl	" "	180/25 mm. : Sulphone b.p. 230/25 mm.
" "	hexyl	" "	195/20 mm. : Sulphone b.p. 220/20 mm.
" "	benzyl	" "	215/35 mm. : Sulphone M.P. 120.
" "	-β-hydroxy ethyl	" "	200/25 mm. : Sulphone b.p. 205/30 mm.

167. Studies on the Polymerisation of Vinyl esters of Aliphatic Acids : Part I. Polymerisation of Vinylcaproate.

C. J. KURIAN and M. S. MUTHANA, Kharagpur.

Vinylcaproate was polymerised using benzoylperoxide and azo-bis-isobutyronitrile as initiators. The extent of conversion was found out by direct analysis for monomer content. The following observations were made :—

1. The rate of polymerisation was found to be a linear function with respect to concentration of benzoylperoxide and azo-bis-isobutyronitrile.

2. The average molecular weight of the polymer increases with conversion.
3. The value for Huggin's constant increases with conversion when benzoyl-peroxide is used as initiator while with azo-bis-isobutyronitrile different order of magnitude is observed.

168. Studies on the Polymerisation of Vinyl Esters of Aliphatic Acids : Part II. Preparation and Polymerisation of Vinyliso-butyrate.

C. J. KURIAN and M. S. MUTHANA, Khargpur.

Vinyl isobutyrate ($n_{D_{20}} 1.3999$; $d_{20}^{25} 0.8826$, B.P. 104°C) prepared by ester interchange reaction between vinyl acetate and isobutyric acid was polymerised using different concentrations of the initiators benzoyl-peroxide and azo-bis-isobutyronitrile.

It is found that the overall rate of polymerisation is a linear function of concentration of benzoyl peroxide upto 0.27% while at 0.543% it is no longer linear. With azo-bis-isobutyronitrile as catalyst the overall rate of polymerisation is a linear function of catalyst concentration over the ranges studied.

The intrinsic viscosity of the polymers in all cases increases with degree of conversion.

169. Studies in the Hydrolysis of Di- and Tri-Chloro-acetaldehydes.

O. P. MALHOTRA and N. D. MISRA, Banaras.

Di- and tri-chloro-acetaldehydes (I and II) were observed among the products of vapour phase chlorination of ethanol under silent electric discharge, and, as no method appears to be known for their estimation when present together and as their reactions are very similar, a detailed study of their hydrolysis (forming basis of many methods for the estimation of II) was undertaken to define, if possible, conditions for the complete hydrolysis of one to the exclusion of the other.

Influence of concentration of the hydrolysant (0.017 to 0.20 N, KOH), temperature ($4-30^{\circ}$) and nature of medium (water; 25% ethanol; 50% ethanol; 25% glycerol) was investigated. The progress of reaction, with time, was followed as usual and the number of moles of KOH used per mole of aldehyde was calculated.

Both the aldehydes were, presumably, hydrolysed in two stages: not clearly differentiable with I but well defined with II. First stage in each required one mole KOH per aldehyde mole, while the complete hydrolysis of I and II, performed separately in pressure bottles at 100° , required 3 and 5 moles KOH respectively. Higher temperatures accelerated the reaction in both cases. Hydroxy compounds favoured the hydrolysis of I and suppressed that of II. Conditions for complete suppression of the hydrolysis of I or II have not yet been found.

170. Synthesis of 3':4'-Methylenedioxy-7-Methyl Dihydro-Flavonol.

M. G. MARATHEY, G. A. ACHARYA and V. G. NAIK, Poona.

Formation of a flavonol from chalkone dibromides has been shown to proceed through a β -hydroxy derivative, a chalkone oxide and a dihydroflavonol. Present work has been undertaken in order to isolate these intermediates in the synthesis of some more cases.

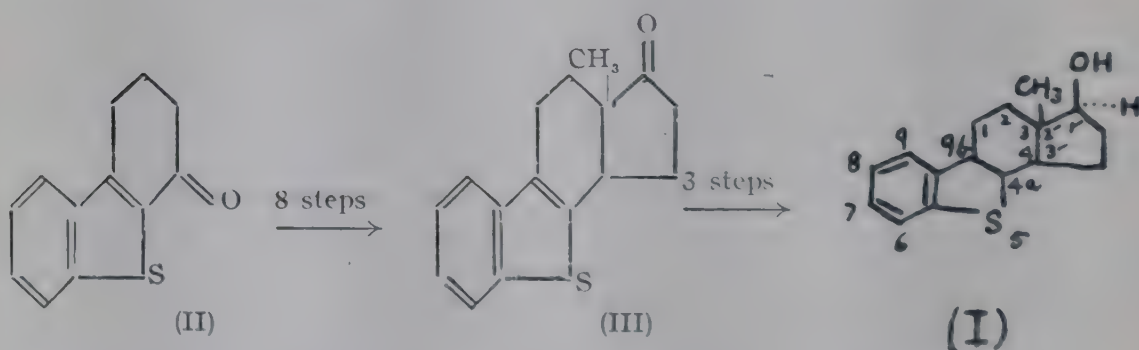
2 Hydroxy-4' methyl acetophenone, I, was condensed with piperonal to give 2'-hydroxy-4' methyl-3:4 methylene dioxy chalkone, m.p. 109° , II, acetate m.p. 115° , III. On bromination with one molecule of bromine, III gave acetoxy

chalkone dibromide, m.p. 119° , IV. IV on treatment with aqueous acetone gave 2-acetoxy-4-methyl-phenyl- α bromo β -hydroxy- β (3:4 methylene dioxy) phenyl-ethyl-ketone, m.p. 120° , V. IV on hydrolysis with Na_2CO_3 gave 3':4' methylene dioxy 7 methyl dihydro flavonol, m.p. 165° , VI, which when treated with NaOH gave 3':4' methylenedioxy-7-methyl flavonol, m.p. 197° , VII. Chalkone II, on alkaline hydrogen peroxide oxidation under different condition gave 3':4' methylenedioxy 7 methyl flavonol, m.p. 197° , and 3':4' methylenedioxy 7 methyl dihydroflavonol. IV on hydrolysis with cold alkali gave 3':4' methylenedioxy-1 methyl flavone, m.p. 211° , VIII, and on hydrolysis with hot NaOH gave 3':4' methylenedioxy 6 methyl benzylidene coumaranone, m.p. 206° , IX.

171. Heterocyclic Steroids—Part II: Synthesis of a Thiophene Analogue of 3-Desoxyestradiol.

R. B. MITRA and B. D. TILAK, Bombay.

In continuation of our study of the rôle of an activated 9:10-double bond of phenanthrene in chemical carcinogenesis by polycyclic hydrocarbons, synthesis of thiophene analogues of steroids has been undertaken. The synthesis of (III), a thiophene analogue of 3-desoxyequilenin, in eight steps starting from the ketone (II) was recently described by us (Mitra and Tilak, *J. Sci. Industr. Res.*, 1955, 14B, 132). This study has now been extended to the synthesis of thiophene analogues of higher hydrogenated steroids. Synthesis of 3:4:2':3'-(1'-hydroxy-2'-methylcyclopentano)-1:2:3:4:4a:9b-hexahydrodibenzothiophene (I), a thiophene analogue of 3-desoxyestradiol, is now described.



Compound (I) was synthesised starting from 3:4:2':3'-(1'-keto-2'-methylcyclopentano)-1:2:3:4-tetrahydrodibenzothiophene (III), in three steps as follows: (i) Oxidation of (III) to the corresponding sulphone; (ii) Catalytic hydrogenation of the B/C ring-junction in the sulphone and (iii) lithium aluminium hydride reduction of the hydrogenated sulphone to (I). In preliminary experiments on model compounds, 1:2:3:4-tetrahydrodibenzothiophene was converted to 1:2:3:4:4a:9b-hexahydrodibenzothiophene in the three steps described above.

172. Action of Trichloro acetic acid on Mono aryl Substituted Thioureas.

G. N. MOHAPATRA, Cuttack.

Action of trichloro-acetic acid on ten different mono aryl (phenyl, *o*- and *p*-tolyl, *o*-, *m*- and *p*-chlorophenyl, *p*-carboxy-phenyl, *p*-nitro-phenyl, α and β naphthyl-) substituted thioureas, in presence of anhydrous sodium acetate in absolute alcohol has been studied. In each case, a halogen free 2-arylimino 4-thiazolidone, synthesized earlier from monochloroacetic acid and mono aryl-thioureas, was isolated

instead of 5:5 dichloro-2-arylimino-4-thiazolidone, which was expected to be the condensation product. A probable mechanism for this reaction has been given in the paper.

173. Bromination of 2-amino thiazoles and their use as possible fungicides and bactericides.

G. N. MOHAPATRA, Cuttack.

Seventeen different 4-aryl (phenyl, *p*-ethyl and *p*-methyl-phenyl; *p*-methoxy and *p*-ethoxy phenyl; *m*- and *p*-amino phenyl, *p*-bromo phenyl, 2-thienyl, α and β -naphthyl, β -phenyl ethyl, and β -(*p*-methoxy phenyl) ethyl) substituted 2-amino thiazoles have been synthesized. These thiazoles have been brominated with help of bromine in glacial acetic acid medium, after protecting the amino groups. The position of the newly entered bromine atom has been ascertained to be at the 5th carbon atom of the thiazole nucleus. The fungicidal and the bactericidal properties of these mono bromo thiazoles have been studied. They are found to be inhibiting completely the spore germination of test fungus '*Alternaria Brassicicola*' at 40 p.p.m. and quite active against *staphylococcus aureus*, even at a dilution of 1:20,000.

174. Synthesis of Isomeric bromo phenyl thiazolyl amines and their relation to biological activity.

G. N. MOHAPATRA, Cuttack.

In the present paper, three isomeric monobromo phenyl-2-thiazolyl amines, three isomeric dibromo phenyl-2-thiazolyl amines and one tribromo phenyl 2-thiazolyl amines have been synthesized, having bromine atom attached to different parts of the molecule. On careful bromination of phenyl 2-thiazolyl amines on the way to synthesize some of its bromo compounds, it has been shown that bromine atom first enters the thiazole nucleus and on further bromination, it enters the phenyl nucleus. Fungicidal as well as bactericidal action of these isomeric bromo 2-thiazolyl anilines have been studied and it has been postulated that when bromine atom is attached direct to thiazole nucleus, it is most active biologically. When bromine atom is attached to the phenyl nucleus of the amino group, the activity decreases and it is least active when bromine is attached to the phenyl nucleus attached to the carbon atom 4 of the thiazole nucleus. Biological activity increases (not proportionally of course) as the number of bromine atoms increases in the molecule.

175. Sugar Cane Wax. A survey of wax contents of press cakes from different sulphitation sugar factories of India.

S. MUKHERJEE, Kanpur.

Thirty-eight samples of air-dry filter cake from Sulphitation factories situated in Bihar, Uttar Pradesh, Bombay, and South India were collected during the crushing season 1953-54. The variety of the cane crushed, the nature of the filter used for filtering the juice and the date of collection of the muds were noted. In some cases, samples were collected in the months of December, February and in April. The wax contents were determined by extraction of a known weight of the mud with benzene in a soxhlet apparatus. The percentage of the hard wax and soft fatty matter was also determined.

It was observed that crude wax contents varied from 1.5% to 20.9%. The wax content also progressively diminished as the crushing season progressed. It was

also seen that press muds from sugar factories situated in Bihar, Uttar Pradesh, Madras and Andhra have a much higher wax content than those from factories situated in Bombay Deccan. It was also noticed that crude wax from northern Indian factories were of better quality than those from other parts of India. Thus crude waxes from Bihar and Uttar Pradesh contained about 70% of hard wax, whereas those from Bombay Deccan and Madras have only 50% of hard wax. Although press mud from the Andhra Sugar Factory, Ltd., Tanuku has the highest wax content, the percentage of hard wax therein is lowest (21.8%).

176. Oil from *Caesalpinia Digyna* (Teri).

MADAN MURARI and B. P. GYANI, Patna.

Teri seeds, which are abundant in many parts of India, contain about 9.4% oil which is free from nitrogen and sulphur. The oil has acid value 1.6, saponification value 190.3, Reichert Meissl value 0.8%, Polenske value 0.9%, iodine value 96 and unsaponifiable matter 1.2 per cent. It is semi-drying and is fit for soap making and cooking.

177. Chemical examination of the fixed oil of *Pithecolobium dulce*, B.

N. BHOJRAJ NAIDU and S. A. SALETORÉ, Hyderabad-Deccan.

Pithecolobium seed oil (*Vilayati imli*) obtained by extracting the kernels of the seeds with petroleum ether b.p. 40-60°C., in 20.5 % yield on the weight of the kernels, is the subject of the present investigation. It is yellow in colour. The physical and chemical constants of the oil have been determined.

The composition of the mixed fatty acids as determined by ester fractionation technique is by per cent weight, caproic, 0.4; capric, 1.0; lauric, 0.7; myristic, 2.5; palmitic, 9.8; stearic, 2.4; arachidic, 5.8; behenic, 11.2; lignoceric, 0.2; hexadecenoic, 4.2; oleic, 40.4; linoleic, 20.5; and C₂₀-C₂₂ acids, 0.9.

The high content of arachidic and behenic acids is noteworthy.

178. 2-p-Amino-Phenylimino-4-Thiazolidone and its Derivatives.

ASKHAYA KUMAR NAIK and M. K. ROUT, Cuttack.

In the present investigation, 2-p-aminophenylimino-4-thiazolidone has been prepared by reduction with iron and acetic acid of the corresponding 2-p-nitrophenylimino-4-thiazolidone. Attempts to prepare this by reaction of the corresponding thiourea and chloroacetic acid failed on account of the presence of the reactive -NH₂ group. To prepare its arylidene derivatives, the conventional method could not be applied on account of the potential carbonyl group combining with the active CH₂ group of thiazolidone nucleus. They have therefore been prepared, in the present investigation, by reduction of the corresponding arylidene derivatives of 2-p-nitrophenylimino-4-thiazolidone.

179. Substituted diphenyl sulphides, sulfoxides and sulphones.

P. K. NARGUND, S. N. KULKARNI and K. S. NARGUND, Dharwar.

Bis-(4-hydroxy halogenophenyl) sulphides are prepared in connection with the work on antibacterials.

Ortho-chlorophenol on condensation with thionylchloride in presence of anhydrous aluminium chloride using carbon disulphide as a solvent, gave 4, 4'-dihydroxy-3, 3'-

dichloro diphenyl sulphoxide m.p. 195°. The sulphoxide on reduction with zinc and acetic acid gave the corresponding sulphide m.p. 179-80°. The sulphoxide on oxidation in acetic acid gave the sulphone m.p. 202°.

Similarly meta-chlorophenol gave 4, 4'-dihydroxy, 2, 2'-dichloro diphenyl sulphoxide m.p. 190°; sulphone m.p. 222°C and sulphide m.p. 120-121° (decomp.).

Meta-bromophenol gave 4, 4'-dihydroxy, 2, 2'-dibromo diphenyl sulphoxide m.p. 188-90° (decomp.); sulphone m.p. 209° and sulphide m.p. 210° (decomp.).

Meta-iodophenol gave 4, 4'-dihydroxy-2, 2'-diiodo diphenyl sulphoxide m.p. 102-104° (decomp.); sulphone m.p. 127-130° (decomp.) and sulphide m.p. 117-119° (decomp.).

180. Synthesis of Glycollic Acid from Formaldehyde, Carbon dioxide and Hydrogen under high pressure.

D. K. NANDI and A. K. GUHA, Kharagpur.

An attempt has been made to synthesise glycollic acid from formaldehyde, carbon dioxide and hydrogen under high pressure. The reaction can be stated by the equation :—



Formaldehyde (36%) was taken in the high pressure reactor. A mixture of hydrogen and carbon dioxide (1:1) was boosted into the reactor. Zinc-copper-chromium was used as a catalyst. The reaction was studied at temperatures from 150°-300°C and high pressure 4000-6700 psi. for about 6 hours. The liquid product released from the reactor was analysed. As the concentration of glycollic acid in the product was very low, the paper chromatographic technique was applied for the detection of acid.

181. Chemical examination of the root bark of *Salacia* species.

P. P. PILLAI and (Miss) A. LAKSHMY, Trivandrum.

Salacia obolonga and *Salacia prunoides* give on extraction, besides large quantities of rubber, petroleum ether extracts soluble in alkali, dulcitol, flavanol glycosides, mainly one melting at 272°C. and phlobatannins. These plants are used in indigenous medicine to treat *diabetes mellitus*,

182. The alkaloids of *Vinca Rosea*, Linn.

P. P. PILLAY and T. N. SANTAKUMARI, Trivandrum.

An alcoholic extract of the root-bark of *Vinca Rosea*, Linn gives about 5% of crude alkaloids which were separated into weak and strong bases. The characteristics of two crystalline strong bases and their salts are given.

183. Chemical Examination of the Latex of *Ficus Bengalensis*, Linn.

P. P. PILLAY and T. N. SANTAKUMARI, Trivandrum.

The latex contains 50% of water, 22.6% of rubber and 24.5% of resin, from which was isolated by repeated crystallisation from alcohol and ethyl acetate, I, amyrin acetate m.p. 224-225°, a melting sterol and liquid sterols.

The aqueous portion of the latex contained the inorganic radicals Mg, K, NO₃ and Cl.

184. Condensation products of Anisalacetone with Substituted Thioureas.**BIPIN BEHARI PRADHAN and M. K. ROUT, Cuttack.**

In the present investigation, the preparation of some secondary thiazolyl amines derived from anisalacetone by condensation with substituted thioureas has been described. The compounds have also been mercurated. Both the mercurated and unmercurated compounds have been studied for fungicidal and bactericidal action. The investigation was undertaken specially to study the effect of a methoxy-styryl group in 4-position on these activities.

185. Studies in the Preparation of 2-Naphthyl Methyl Ether.**DHARAM PRAKASH, JAGRAJ BEHARI LAL and RAMESH CHANDRA GUPTA, Kanpur.**

2-Naphthyl methyl ether or Yara Yara possesses an odour somewhat resembling Neroli oil. It is widely used in perfumery practice to produce neroli note in perfumes and in cheap cologens.

Using a modification of the procedure of Lewis, Sherman, Trieschmann and Cogan (Ind. Eng. Chem., 1930, 22, 34), a study of the various factors influencing the yield of 2-Naphthyl methyl ether such as the proportion of 2-Naphthol, dimethyl sulphate, caustic soda, water etc. has been made.

From the investigations, the following conclusions were arrived at :—

- (1) For a fixed molar ratio of water, 2 naphthol (1 mol.), and dimethyl sulphate (0.5 mol.) the yield of 2 naphthyl methyl ether increases with decreasing molar ratio of caustic soda to 2-naphthol.
- (2) With decreasing moles of water per mol of 2-naphthol and a constant molar ratio of caustic soda per mole of 2-naphthol and 0.5 mol. of dimethyl sulphate, the per cent yield of the theoretical (calculated on 2-naphthol used), decreases with the increase in the molar ration of caustic soda to 2-naphthol.
- (3) The use of one mole of caustic soda per mol. of 2-naphthol results in the maximum yield of 2-naphthyl methyl ether. The use of caustic soda more than in molar proportion to 2-naphthol, results in decreased yield of the ether the reaction time being the same.

186. Fatty Acid Composition of Fat from the Seeds of Shorea Robusta.**OM PRAKASH, A. C. GUPTA and S. RAI, Kanpur.**

The sal tree, botanically called *Shorea Robusta*, grows in abundance in the Tarai region of northern India. The kernels obtained from the fruits of the tree yield a fat of pale green colour which has been reported to be a substitute for cocoa butter, which is valuable fat used in confectionery. It also resembles tallow which is a good sizing material in the textile industry besides being a valuable soap-making fat. The fatty acid composition of sal seed fat as reported by different workers varies over wide limits. A sample of sal seed fat obtained from Indian sources has been found to be 8.0% palmitic, 34.5% stearic, 12.2% arachidic, 41.4% oleic and 2.9% linoleic acids. This resembles closely that of cocoa butter except for the difference that the latter does not contain any arachidic acid and has a larger percentage of palmitic acid.

187. Radish Seed Oil.

OM PRAKASH, ATMA RAM and J. N. TANDON, Kanpur.

Radish seed oil is extracted from the seed of *Raphanus Sativus*. This is an annual herb and is cultivated throughout India.

No systematic work seems to have been done on the extraction of the oil from this seed and examination of the oil and the cake.

The seed contains about 32.5% of oil of the following physical and chemical constants :—

Sp. gr. at 30°C/30°C—0.9081; Ref. Index at 40°C—1.4640; Viscosity (Redwood) at 140°F—105 secs.; Acid value—5.7; Sapon. value—177.4; I.V.—93.1; Acetyl value—15.5; Total fatty acids including unsaponifiables—94.0.

The oil belongs to the non-drying class and appears to be suitable for soap making and for illuminating and edible purposes.

The cake has the composition : Nitrogen content 5.7%; Proteins 36.73%; Ash content 7.4%; Carbohydrates and fibre 53.8%, and appears to be suitable for feeding and manurial purposes.

188. 5-Arsonophenyl-2-Arylimino-4-Thiazolidones.

H. K. PUJARI and M. K. ROUT, Cuttack.

In the present investigation, for enhanced amoebicidal action, ten different 5-arsonophenyl-4-thiazolidones have been synthesised. The experimental procedure is based on the reaction reported by Mohlau & Berger and Kuhling and others. Reasons for assuming the attachment of the arsonophenyl group to 5-position of the thiazolidone nucleus have been discussed.

189. Essential Oil from the Leaves of *Eugenia Jambolana* or Jamun.

S. K. RAMASWAMI and D. R. DHINGRA, Kanpur.

The leaves of *Eugenia Jambolana* or 'jamun' yield an essential oil having an agreeable odour. Its physico-chemical properties are :—Sp. gra. at 20°C—0.8943; Ref. index at 22°C 1.45; Optical rotation—13.2; Soluble in 5 vols. of 90% alcohol; E.V. 35.47; E.V. after acetylation 66.89.

The oil contained about 30% terpenes (probably Limonene and dipentene), about 40% of a sesquiterpene of the Cadalene type, and minor quantities of azulenes.

Further work is in progress.

190. Dihydrotriazines as Potential Antimalarials.

A. RAYCHAUDHURI, Calcutta.

The isolation of a dihydrotriazine as an active metabolite of Paludrine and search for anticancer compounds led to the synthesis of this new class of compounds with antivitamin and antimalarial activity (Carrington *et al.*, *Nature*, 1951, 168, 1080; Modest *et al.*, *J. Amer. Chem. Soc.*, 1952, 74, 855; Ray *et al.*, *J. Indian Med. Assoc.*, 1954, 24, 169). In view of the above observations some dihydrotriazines have been prepared from arylamines possessing either antibacterial or antimalarial activity. *p*:*p'*-Diaminodiphenyl sulphone, *p*-methylsulphonyl aniline, and 3-diethylaminomethyl-4 hydroxy aniline were reacted with dicyandiamide, acetone and hydrochloric acid to afford (i) *p*:*p'*-di-(2:4-diamino-1:6-dihydro-6:6-dimethyl-1:3:5-triazin-1-yl)-diphenyl sulphone hydrochloride (m.p. 236-238°; $\lambda_{\text{max}}^{\text{NIO}}$ 10.0 HCl

240m μ), (ii) 2:4-diamino-1-p-methylsulphonyl phenyl-1:6-dihydro-6:6-dimethyl-1:3:5-triazine hydrochloride (m.p. 242°; $\lambda_{\frac{H_2O}{max}}$ 241-242 m μ and (iii) 2:4-diamino-1-(3'-dimethylaminomethyl-4'-hydroxy)-phenyl-1:6-dihydro-6:6-dimethyl-1:3:5-triazine hydrochloride (m.p. 196° $\lambda_{\frac{H_2O}{max}}$ 241 m μ). Sulphanilamide reacted with dicyandiamide, methylethyl ketone and hydrochloric acid to yield 2:4-diamino-1-p-sulphonamido phenyl-1:6-dihydro-6-methyl-6-ethyl-1:3:5-triazine hydrochloride (m.p. 210°; $\lambda_{\frac{H_2O}{max}}$ 244-245 m μ).

191. Chromatographic study of several samples of Cashew nut shell Liquid obtained by various Process of Extraction.

(Miss) K. K. ROHATGI, P. K. SANYAL and M. ADHIKARY, Calcutta.

Cashew-nut shell liquid has been proved to be an excellent medicine for a large number of Helminthic diseases. In the present work an attempt has been made to separate the cashew-nut shell liquid obtained by various methods of extraction into fractions with a view to isolate and identify the most active portion.

Three samples of cashew-nut shell liquid, viz. (1) raw cold expressed liquid, (2) Solvent extracted liquid and (3) Phenolic portion of a decarboxylated liquid, were separated chromatographically on alumina using a mixture of benzene and petroleum ether as solvent.

The large number of zones obtained shows that cashew-nut shell liquid is not a simple mixture of two or three components. However, only two or three fractions could be eluted with difficulty and in poor yields. No ancardic acid was obtained from sample No. 1. The liquid chromatograms obtained from the three samples were not identical, although some common fractions were obtained from all of them.

Other methods of separation were also tried.

192. Studies on Diazoketones—Part I: Preparation of w-Methoxy-o-hydroxy acetophenones. A New Synthesis of Karanjin Ketone.

L. RAMACHANDRA ROW and D. VISWESWARA RAO, Waltair.

Yates (*J. Amer. Chem. Soc.*, 5376, 1952) showed that ^{per. 7*}copper bronze catalyses the decomposition of diazoketones in anhydrous alcoholic solutions to give rise to w-alkoxy acetophenones. This reaction is now successfully applied for the preparation of w-methoxy-o-hydroxy acetophenones. In the first instance, the acetyl derivative of 4-methoxy-2-hydroxy-benzoic acid was converted into the acid chloride with the help of thionyl chloride and interaction of the acid chloride with diazomethane furnished 4-methoxy-2-acetoxy-w-diazo-acetophenone, (m.p. 100-5°). The latter underwent facile decomposition when boiled with copper bronze in anhydrous methyl alcoholic solution. From the crude solution was isolated w:4-dimethoxy-2-hydroxy-acetophenone; m.p. 69-70° (alone or mixed with authentic sample obtained by partial methylation of w-methoxy-2:4-dihydroxy acetophenone). Yield: 42%.

Likewise, β -resorcylic acid was converted into w-methoxy resacetophenone m.p. 136-8°, (Yield 43%) identical with an authentic sample of the ketone obtained by Hoesch synthesis.

Also, karanjin acid, 4-hydroxy-coumarone-5-carboxylic acid was converted into 5-(w-methoxy) acetyl-4-hydroxy-coumarone, m.p. 96-7°, (yield: 30%) in a similar manner. The latter was identical with karanjin ketone obtained by alkaline hydrolysis of karanjin. This constitutes a new and facile synthesis of karanjin ketone.

The above syntheses demonstrate clearly the possibility of conversation of o-hydroxy aromatic carboxylic acids into w-methoxy-o-hydroxy acetophenones. The

procedure developed above is now under exploitation for obtaining new w-methoxy ketones which have hitherto resisted synthesis.

192A. Experiments on Stereospecific Synthesis of Resin Acids.

N. N. SAHA, U. R. GHATAK and P. C. DUTTA, Calcutta.

In continuation of the experiments described in previous communications investigations have been extended to the bicyclic system, 10-methyldecalin-1-one. This has been condensed with ethyl cyanoacetate to give the corresponding unsaturated ester ($180^{\circ}/4$ mm.). Elements of hydrocyanic acid have been added to it to yield the dicyano-ester ($180-85^{\circ}/0.3$ mm.). This on hydrolysis with acids leads to the dibasic acid (m.p. 175°). This on esterification with diazomethane leads to the diester ($147^{\circ}/15$ mm.). On partial hydrolysis with potassium hydroxide, it gives the ester acid (m.p. $161-62^{\circ}$), where the primary carbomethoxyl group has been preferentially attacked. The corresponding silver-salt of the ester-acid has been prepared and this is allowed to undergo Hunsdiecker's degradation with bromine in carbon tetrachloride, leading to the bromo-ester ($135-40^{\circ}/0.2$ mm.). On refluxing with zinc dust/acetic acid, the related methyl ester is obtained ($120-22^{\circ}/4$ mm.). This on hydrolysis with potassium hydroxide gives the crystalline acid—1:10-dimethyldecalin-1-carboxylic acid (m.p. 120°) in which the two methyl groups are most probably in *cis*-position as present in abietic acid.

192B. Improvement in the Technique of Vacuum Distillation of Organic Liquids.

S. K. SAHA, Calcutta.

Vacuum distillation has been very much simplified by the development of a new technique by which heating is done by ring burners having concentric rings with very minute apertures. By this the distilling flask remains enveloped in a uniform hot atmosphere and the distillation is smooth and steady. The device works automatically, ensures uniform heating and yields purer products with significant ease in considerably less time and further still with very much less labour than before. Not only has the new technique made vacuum distillation in the laboratory a simple and easy affair but also it can be extended to large scale industrial operations mostly by substituting larger stainless steel flasks for the glass flasks.

192C. A Note on the Preparation of Cyanacetic Acid Hydrazide.

S. K. SAHA, Calcutta.

An improved method has been developed for the preparation of Cyanacetic Acid Hydrazide or 'Cyanazid' which has recently come into prominence for its potent antitubercular activity. Cyanacetic ester is treated with a slight excess of molar portion of hydrazine hydrate in large volume of alcohol below 5°C with continuous stirring. Very good yield of analytically pure hydrazide is directly obtained m.p. $110^{\circ}-112^{\circ}\text{C}$.

The only known method of its preparation in literature gives coloured product very difficult to purify.

192D. Synthesis of Cyclohexane-1:1-Dicarboxylic Acid.

JATINDER MOHAN SAGAR and G. S. SAHARIA, Delhi.

Cyclohexanone was condensed with ethyl cyano acetate to give ethyl cyclohexylidene cyano acetate; the unsaturated ester was treated with alcoholic potassium

cyanide and subsequent hydrolysis of the dicyano-ester yielded 1-carboxy cyclohexane-1-acetic acid. Bromination of 1-carboxy cyclohexane-1-acetic acid furnished 1-carboxy cyclohexane-1- α -bromo acetic acid which on alkaline hydrolysis gave 1-carboxy cyclohexane-1-glycollic acid. The glycollic acid was then subjected to oxidation with alkaline potassium permanganate to give cyclohexane-1:1-dicarboxylic acid.

192E. Synthesis of Condensed Cyclic Systems.

KALYANMOY SEN and P. BAGCHI, Calcutta.

A synthesis of 8-methyl-0:3:4-bicyclononane-4-one has been described by Bagchi and Banerjee (*J. Ind. Chem. Soc.*, 1946, **23**, 397) in which a keto group in the desired position was introduced by conversion of a carboxyl into a ketonic function. The present paper describes a modification of the previous method, in which the number of steps has been considerably shortened and has resulted in the synthesis of 7-methyl-0:3:3-bicyclooctane-3-one (V).

Condensation of 2-methyl-2-carbethoxy cyclopentylidene cyanoacetate with ethyl chloroacetate in the presence of alcoholic sodium ethoxide furnishes diethyl 1-cyano-1-(2'-methyl-2'-carbethoxy)- Δ' -cyclopentenyl succinate (I) b.p. 175-76°/0.6 mm. (67%). This on hydrolysis and esterification gives diethyl 1-(2'-methyl-2'-carbethoxy)- Δ' -cyclopentenyl succinate (II) b.p. 167-70°/5 mm. (42%). Dieckmann cyclisation of II followed by hydrolysis yields Δ^4 -7-methyl-0:3:3-bicyclo-octene-1-one-3-carboxylic acid (III) m.p. 122° (47%). Huang-Minlon Reduction of (III) gives Δ^3 -7-methyl-0:3:3-bicyclo-octene-3-carboxylic acid (IV) b.p. 135-136°/1.5 mm. (30%). On being subjected to Schmidts reaction the latter furnishes 7-methyl-0:3:3-bicyclo-octane-3-one b.p. 85-95°/5 mm. (31%) D.N.P. m.p. 177-78°.

A further simplification of the above scheme has been achieved by cyclization of (I) followed by hydrolysis when Δ^4 -7-methyl-0:3:3-bicyclo-octene-1-one-3-carboxylic acid is obtained in 36% overall yield.

193. Chemistry of Aliphatic Thiocarbamides—Part III: Tetramethyl-Thiocarbamide.

RANBIR SINGH, Banaras.

Delepine's method (*Bull. Soc. Chim.*, 1910, (iv) **7**, 988) of the formation of tetramethylthiocarbamide did not prove satisfactory for the preparatory purposes. It was prepared therefore, as per Sahasrabudhey's method (*J. Ind. Chem. Soc.*, 1951, **28**, 341).

The interaction of tetramethylthiocarbamide with oxidising agents like bromine, chlorine and perchloric acid was investigated and bromide m.p. 158.0-158.5°, chloride m.p. 100° and perchlorate were obtained. Oxidation in the presence of alkali was also tried, but no definite product could be isolated; a part of the sulphur of the compound gets oxidised to sulphuric acid.

Tetramethylthiocarbamide is desulphurised with freshly prepared copper powder in benzene to the extent of 30% only in about 4 hours. Degradation of tetramethylthiocarbamide with zinc dust has been carried out; picrate of the base obtained, m.p. 195°.

No complexes with silver nitrate could be isolated but the solution after evaporation left a syrupy liquid which did not respond to tests for ionic silver indicating a highly soluble complex. Like other aliphatic thiocarbamides, tetramethylthiocarbamide is not decomposed by acid hydrolysis; normal and 5 normal caustic soda solutions, however, give 0% and 45% amine and 0% and 58.8% H_2S respectively. It can be estimated titrimetrically with iodine and mercuric nitrate solutions. It gives a benzyl derivative (m.p. 50°C) with benzyl chloride in dilute alcohol.

194. Chemistry of Aliphatic Thiocarbamides—Part IV: Trimethylthiocarbamide.

RANBIR SINGH, Banaras.

Trimethylthiocarbamide was prepared by the condensation of methyl-mustard oil and dimethylamine in alcoholic solution, m.p. 87°C . 0.4360 gm. of the substance in 25 cc., 30 cc. and 35 cc. of water gave a depression of 0.265° , 0.23° and 0.19° respectively, corresponding with the molecular wt. 118.74, 113.7 and 118.0.

Trimethylthiocarbamide is stable towards boiling normal and five normal sulphuric acid, and normal caustic soda solutions, however, with five normal caustic soda, after heating for one hour, 41% amine and 43% H_2S were obtained. Alkaline cadmium sulphate, in cold and boiling solutions proved ineffective to desulphurise the substance.

Trimethylthiocarbamide forms complexes with silver nitrate. With equimolecular quantities of the reactants or with a moderate excess of thiocarbamide at 0° or ordinary temperature $(\text{CH}_3)_2\text{N}.\text{CS}.\text{NH}(\text{CH}_3)$, AgNO_3 was the principal product. With a moderate excess and large excess of silver nitrate $(\text{CH}_3)_2\text{N}.\text{CS}.\text{NH}(\text{CH}_3)$, 2AgNO_3 and $(\text{CH}_3)_2\text{N}.\text{CS}.\text{NH}(\text{CH}_3)$, 3AgNO_3 respectively were obtained. No compounds could be isolated in boiling solutions with any proportions of the reactants and with a large excess of thiocarbamide at ordinary temperature.

Like other thiocarbamides, trimethylthiocarbamide can also be estimated titrimetrically with iodine and mercuric nitrate solutions. With nitrous acid in acetic acid medium, it gives a nitroso derivative, a very unstable oily liquid. With acetic anhydride and benzyl chloride it forms acetyl and benzyl derivatives, m.ps. 148°C and 154°C respectively. On treatment with bromine a sticky 'disulphide' oxidation product is obtained.

195. Desulphurisability of Thiocarbamides.

RANBIR SINGH, Banaras.

It has been reported (Dixon, *J. Chem. Soc.*, 1893, **63**, 318; Sahasrabudhey and Krall, *J. Ind. Chem. Soc.*, 1944, **21**, 63) that as against easy desulphurisability (by heavy metal oxides) of mono- and di-aryl and mono-alkyl N-substituted thiocarbamides, the dialkyl substituted products do not undergo desulphurisation. Contrary to this, it has now been found that excepting tri- and tetra-methyl thiocarbamides all aliphatic substitution products are more or less desulphurisable, the extent of the change depending on the nature and number of substituents. For example, potassium zincate at 60° and 80° indicates the following order of desulphurisation :

Trimethylthiocarbamide 0%, sym. dimethylthiocarbamide 2.1%, as-dimethylthiocarbamide 6.0 and 14.4%, as-diethylthiocarbamide 6.25 and 24%, methylthiocarbamide 10 and 29%, ethylthiocarbamide 12 and 32%, thiocarbamide 13 and 37% respectively.

196. A new synthesis of disulphoxides.

R. H. SAHASRABUDHEY and B. N. TRIVEDI, Banaras.

Work of Smiles and coworkers (*J. Chem. Soc.*, 1924, 176; 1925, 224) would appear to have almost settled the much debated question of the structure of disulphoxides in favour of the unsymmetrical formula RSO_2SR in preference to RSOS(O)R and RSOSOR . In view of the new general acceptance of the symmetrical structure for dithionous acid $\text{HSO}_2\text{SO}_2\text{H}$ (*Current Science*, 1953, **22**, 74) a synthesis of disulphoxides was undertaken along the following lines.

The appropriate sulphonic acids were converted through their acid chlorides into the corresponding (alkali salts of) sulphinic acid. These on treatment with

thionyl chloride by Hinch's procedure [J. Chem. Soc., 1910, 97, 1191] gave sulphanyl chlorides RSOCl . These last on treatment with finely divided silver lost in dry petroleum ether gave the corresponding disulphoxides which were identified by determination of m.p., sulphur and molecular weight. Thus *p,p'*-diethoxy-, *p,p'*-diethoxy-, 4, 4'-dichlorodiphenyl- and 4, 4'-dibromodiphenyl-disulphoxides were obtained.

These syntheses strongly support the symmetrical structure RSOSOR and demand a reconsideration of this issue.

197. Assessment of Quality in Asafoetida.

L. V. L. SASTRY, M. SRINIVASAN and V. SUBRAMANYAN, Mysore.

The main difference in derivation, properties and uses, as described in the literature, of the two major varieties of asafoetida known to trade as *Hing* and *Hingra* are emphasised. A sample of *Hingra* examined had alcohol (90 per cent) soluble matter as high as 70 per cent. This sample was homogeneous in character. On the other hand, the *Hing* samples examined had alcohol soluble matter varying from 33 to 42 per cent. The familiar smell of asafoetida was a feature of most of the Irani *Hing* samples, while foreign odours were associated with some of the Fathani *Hings* and with *Hingra*. Mere analysis (alcohol soluble matter or ash content) does not reveal varietal differences which are physical and organoleptic in character. Chemical tests, some known and some evolved by us on the basis of certain functional groups in asafoetida, have been investigated with a view to adopting them as a means of distinguishing between varieties hitherto based on smell. The need for a revision of the current standards for asafoetida as to include a clause relating to its organoleptic quality is pointed out.

198. Synthesis of 'Vanitrope' (4-ethoxy-3-hydroxy-propenyl benzene).

V. D. N. SASTRI and S. H. JAHEER, Hyderabad-Dn.

"Vanitrope" which is a trade name for 3-hydroxy-4-ethoxy-propenyl benzene has been reported to be a very powerful perfume and flavouring agent, being several times more potent than Vanillin in this respect.

The synthesis of this substance starting with *p*-hydroxy benzaldehyde has been attempted. Simultaneously, a more promising method which can be adopted for the large scale preparation of Vanitrope has also been explored. The latter synthesis starts with eugenol which is ethylated to *O*-ethyl eugenol and isomerised to *O*-ethyl isoeugenol.

Attempts to partially demethylate *O*-ethyl isoeugenol to 4-ethoxy-3-hydroxy-propenyl benzene have been made.

199. Possible plant Hormones.

N. B. SATTUR, S. N. KULKARNI and K. S. NIKHUND, Dharwar.

In order to prepare open chain homologues of Indole acetic acid as possible plant hormones, we have condensed dichloro and trichloro anilines with chloroacetic acid and 3-chloropropionic acid in presence of sodium acetate using 50% acetic acid.

2,3-Dichloro-phenyl glycine m.p. 164-5°; ethyl ester m.p. 55°; methyl ester m.p. 52-53°. 3,2,3-Trichloro-anilino-propionic acid m.p. 119-20°; ethyl ester m.p. 54-56°; methyl ester m.p. 59-60°.

2:4-Dichlorophenyl glycine has m.p. 152-53°; ethyl ester m.p. 38-39°; methyl ester m.p. 58-59°. β 2:4-Dichloro-amino-propionic acid m.p. 98-99°; ethyl ester b.p. 150-55° at 15 mm.; methyl ester b.p. 199-200° at 18 mm.

3:4-Dichlorophenyl glycine m.p. 141-42°; ethyl ester m.p. 104°; methyl ester m.p. 109-110°; β 3:4-Dichloro-amino propionic acid has m.p. 105-106°; ethyl ester b.p. 200° at 15 mm.

2:4:5-Trichlorophenyl glycine has m.p. 192-93°; ethyl ester m.p. 82°; methyl ester m.p. 110°. β 2:4:5-Trichloro-amino-propionic acid showed m.p. 132°.

200. Possible Antiamoebic Agents—Mannich Bases from 8-Hydroxy-Quinolines.

A. B. SEN and YASHWANT D. KULKARNI, Lucknow.

Several Mannich bases have been prepared from 8-hydroxy quinoline-5-sulphonic acid, formaldehyde and different secondary amines, with a view to test them for their antiamoebic activity.

201. Synthesis of some Aryl Sulphones.

A. B. SEN and A. K. ROY, Lucknow.

Several aryl sulphones have been prepared by the application of Fries rearrangement and Friedel and Crafts reaction with a view to test the antibacterial activity.

All the ten sulphones synthesised are enlisted below :—

No.	Sulphones	M.P./b.p. °C/mm.
1.	4-hydroxy-5-chloro-2-methyl phenyl p-toluene-	... 276
2.	2-hydroxy-3-5-dichloro phenyl p-toluene- ...	... 152
3.	2-methoxy-5-tert. butyl phenyl p-toluene- ...	... 98
4.	4-methoxy-5-tert. butyl 2-methyl phenyl p-toluene-	... 100/4
5.	2-phenyl 5-methoxy phenyl p-toluene- ...	... 172
6.	2-methoxy 5-tert. amyl phenyl p-toluene ...	... 125
7.	4-ethyl phenyl p-methoxy benzene- ...	... 98
8.	4-sec. amyl phenyl p-methoxy benzene- ...	... 77
9.	4-ethyl phenyl p-chloro benzene- ...	... 120
10.	4-sec. amyl phenyl p-chloro benzene- ...	... 148

202. Search for New Insecticides—Part B.

A. B. SEN and A. K. SEN GUPTA, Lucknow.

Webster and Marshall found that commercial preparations containing xanthenes were effective against codling moth.

With a view to study the insecticidal activity, xanthenes containing alkyl, halogen, methoxy and amino-groups have been synthesised by following the method of Ullmann (*Ber.*, 1904, **37**, 853-54) and Seshadri and Panakjamani (*J. Sci. Industr. Res.*, **13A**, 396, 1954).

203. Search for New Insecticides—Part C : Synthesis of Substituted ω Dichloro acetophenone.

A. B. SEN and A. K. SEN GUPTA, Lucknow.

The present paper describes the preparation of a number of phenolic esters of dichloroacetic acid and o-hydroxy ω dichloroacetophene. These esters are expected to be good contact insecticides as the ketonic and the ester groupings

should impart lipophilic and the hydroxy grouping hydrophilic property to the compounds (Lauger, Martin and Muller, *Helv. Chim. Acta*, 1944, **27**, 918).

The phenolic esters of dichloro acetic acid were prepared by following the method of Spasov (*Ann. Univ. Sofia II, Faculte phys-maths.*, 2, 35, 289-93, 1938-39) and the phenolic ketones were obtained by the Fries rearrangement of the above esters in the absence of a solvent using 1.2 to 1.3 moles of anhydrous aluminium chloride. The insecticidal activity of these compounds is under investigation at the Central Laboratories, Hyderabad-Dn.

204. Separation and identification of hydroxy acids present in Shellac by Paper Chromatograph.

S. C. SEN GUPTA, Ranchi.

To separate, identify and estimate the various hydroxy acids present in shellac by the help of paper chromatography, preliminary work was undertaken with some of the known hydroxy acids obtained from hydrolysed shellac e.g., butolic (monohydroxypentadecanoic), aleuritic (trihydroxypalmitic) and its isomer, and shellolic (an oxidised sesquiterpene having two hydroxyl and two carboxyl groups) acids. In addition, two isomeric dihydroxystearic acids were also included in the investigation. In aqueous butanol-formic and -acetic acids monohydroxy and dihydroxy acids moved with the solvent front. Aqueous ethyl alcohol-ammonia and butanol-ammonia solutions gave very good separation of the acids and the R_f values could be altered considerably by varying the amount of water. The isomeric acids travelled with the same speed in all the solvents. The R_f values of butolic acid, dihydroxystearic acids, aleuritic acids and shellolic acid in the solvent 95% ethyl alcohol-liquor ammonia (100:4) were 0.81-0.82, 0.79-0.80, 0.71-0.72 and 0.31-0.33 respectively.

205. Synthesis of Lactic Acid from Acetaldehyde, Carbon monoxide and Water under high pressure and its Identification by Paper Chromatography.

S. P. SEN GUPTA, A. K. GUHA and J. K. CHAKRABARTI, Kharagpur.

Investigation is being carried out on the synthesis of lactic acid from CH_3CHO , CO and H_2O under high pressure using nickel iodide as catalyst. The reaction was carried out under 550-600 atmospheres at about 250°C for about four hours. The usual analytical methods for the examination of the acid could not be pursued due to the presence of other compounds including side reaction products and unreacted acetaldehyde, the removal of which requires a tedious procedure. The paper chromatography, after some preliminary purification of the product, proved a very convenient method for this. Purified lactic acid was run on the filter paper concurrently with the product. The chromatograms were sprayed with either bromothymol blue or bromophenol blue to yield yellow acid spots against a blue or purple background. The nature and R_f value of the spot obtained from the product revealed its identity with lactic acid.

$R_f \times 100$

		CHCl ₃ —Ethanol —HC OOH (85%) 50 : 50 : 1	Benzyl alcohol-n- butyl alcohol- formic acid (85%) 50 : 50 : 1	Benzyl alcohol- Ethanol—water- formic acid (85%) 60 : 60 : 10 : 3
Product	...	76	62	70
Lactic acid	...	77	63	70

206. Chemical Composition of the fatty oil obtained from the seeds of *Ocimum canum*, Linn.

M. A. SHAIKH and V. A. PATWARDHAN, Sangli.

The fatty oil was obtained to the extent of 8% from the small seeds of the plant, *Ocimum canum* (Rantulas), grown in Sangli. The analysis of the greenish yellow oil gave the following constants:—Sp. gr. at 27.7°C., 0.9298; Refractive Index at 29.5°C. (Abbe'), 1.4832; Acid V. 6.2; Sap. V. 191.1; Iodine V. (Wijs) 188.7; Acetyl V. 29.5; R.M.V. 1.54; Polenske V. 0.5; Unsaponifiable—matter 2.25%. The drying power of the oil was found to be 16.5%.

The mixed fatty acids yielded by means of Twitchell's—method 6% solid acids and 94% liquid acids. The composition of the liquid acids, determined by the bromination method, is as follows: α -Linolenic 14.4, Isomeric linolenic 7.2, α -Linoleic 10.1, Isomeric linoleic 54.8, and Oleic 13.5 per cent.

On bromination of the fatty oil, two bromoglycerides of isomeric dilinolenolins melting at 157° and 146°C., and a bromoglyceride of linolenol-dilinolein, M.P. 81°C., were obtained.

207. Investigations on Black Dammar. (Isolation of a diterpene hydrocarbon).

P. S. SHANKAR and M. S. MUTHANA, Kharagpur.

A white needle-shaped crystalline compound, m.p. 170-173°C, was isolated from the alcoholic extract of the resin, Black Dammer (*Canarium Strictum* Roxb) by fractional crystallization on filter paper according to the method developed by R. C. Vasisth and M. S. Muthana. [Nature, 172, 862, (1953)].

Analytical studies of the purified compound have shown it to be a diterpene hydrocarbon.

208. Substituted Benzyl amines and their Derivatives.(Miss) H. S. SHARADAMMA, S. N. KULKARNI and K. S. NARGUND,
Dharwar.

Dichlorobenzaldehydes were for the first time prepared in good yields from the corresponding dichloroanilines by the procedure described by Beech (J. Chem. Soc., 1954, 1299). p-n-Butylaniline was prepared by Hickinbottom method (J. Chem. Soc., 1920, 117, 103) and converted into the p-n-butylbenzaldehyde by Beech's method. The substituted benzaldehydes were subjected to Leuckart reaction by the method of K. G. Lewis (J. Chem. Soc., 1950, 2249).

2:5-Dichlorobenzylamine has boiling point 135-60° at 9 mm.;—picrate m.p. 230°; hydrochloride m.p. 268°.

3:4-Dichlorobenzylamine distilled at 175-85° at 25 mm.; picrate m.p. 228°; hydrochloride m.p. 244°.

2:4-Dichlorobenzylamine distilled at 210-20° at 16 mm.; picrate m.p. 261°; hydrochloride m.p. 295°.

p-n-Butylbenzylamine has boiling point 220-235° at 21 mm.; hydrochloride m.p. 265°.

3:5-Dichlorobenzylamine gave hydrochloride m.p. 300°.

209. Plant Chromosomes and Related structures—their Chemistry—II.

ARUN KUMAR SHARMA and (Miss) MIRA ROY, Calcutta.

The present report has dealt with the activity of acid phosphatase in different cellular parts of root-tips of *Allium cena*. Incubation for overnight by Gomori's

method as modified by Glick and Fischer has been found to be very effective and so used both for control as well as experimental treatments involving digestion through proteolytic enzymes and nucleic acid extraction. The following conclusions have been arrived at:—

1. Following simple pepsin and trypsin treatment before incubation, it has been noted that the distribution of acid phosphatase in the basic protein of the cytoplasm is more, as compared to that of the non-basic one. This is, however, in relation to the free protein and not the nucleoproteins. The picture finds to some extent contrary to that obtained following tests for alkaline phosphatase in previous works.

2. Incubation proceeded by extraction of nucleic acid results in a considerable loss of acid phosphatase activity throughout the cell indicating the presence of the enzyme in high concentration in the nucleic acid.

The same treatment at the same time causes a crisp appearance of the nucleolus, which is of course much reduced in volume indicating possibly the compact nature of the protein molecules of the same.

3. Simultaneous treatment of tissue for nucleic acid extraction followed by enzyme digestion before incubation reveals that the basic protein of the cytoplasm is very high in phosphatase content. The activity of nucleoplasm is mainly confined to the nucleic acids. Just like the cytoplasm in the nucleolus too, the content of acid phosphatase in basic protein is quite higher than in non-basic proteins. In chromosomes, its slight presence in non-basic protein could be noted, but the localization of basic proteins could not be made due to the loss of structural identity of chromosomes following pepsin treatment. The experiment once more emphasizes that the ultimate skeleton of the chromosome is mainly composed of non-basic proteins. The evidence of structural identity through non-basic protein was also obtained following test for alkaline phosphates.

210. Chemical examination of the seeds of *Psoralea Corylifolia* L., Part I. On the isolation and Constitution of Corylifolean.

S. SIDDAPPA and Y. V. SATHYABHAMA DEVI, Bangalore.

A new crystalline substance $C_{17}H_{18}O_3$ (m.p., 183-183.5°) has been isolated from the seeds of *Psoralea Corylifolia* and named *Corylifolean*. Corylifolean does not contain any methoxyl group and on acetylation gives *acetylcorylifolean* $C_{19}H_{20}O_4$ (m.p., 87-88°) accounting for one of the three oxygen atoms. Corylifolean and acetylcorylifolean behave as lactones. On catalytic hydrogenation corylifolean yields *dihydrocorylifolean*, $C_{17}H_{20}O_3$ (m.p., 175-6°) and on bromination a tribromoderivative $C_{17}H_{17}O_3Br_3$ (m.p., 226-27°). Quantitative estimations correspond to the presence of one isopropylidene group $\left(=C \begin{array}{l} \nearrow CH_3 \\ \searrow CH_3 \end{array} \right)$ in Corylifolean. Ozonolysis of corylifolean gives acetone and a compound $C_{14}H_{12}O_4$ (m.p., 166-67°). Nitric acid oxidation of corylifolean yields oxalic acid and a nitro-phenolic acid (m.p., 54-55°). The results of oxidation experiments with corylifolean using nitric acid and chromic acid are discussed and a provisional structure for Corylifolean as a tetrahydrobenzocoumarin derivative is advanced.

211. Studies on Indigoid dyes : Part I. 2-(5-Iodo) thionaphthene-acenaphthylene- and phenanthrene-indigos.

ARUN KUMAR SINHA, Patna.

The following new dyes have been prepared by condensation of 5-iodothioindoxyl with acenaphthenequinone : 3-bromo-, 5-nitro-, 5 : 6-dinitroacenaphthene-

quinone, and with phenanthraquinone, 2-bromo-, 4-nitro-, 2:7-dinitro-phenanthraquinone and aceanthraquinone. The properties of these compounds and their dyeing qualities have been studied.

212. Preparation of alkyl substituted phthaleins.

ATMA RAM SRIVASTAVA and H. L. ROHATGI, Kanpur.

Amongst the alkyl substituted phenolphthaleins only diethyl phenolphthalein has been so far prepared and reported by Ix Lax Ltd. We have found that the application of Fries reaction to the corresponding acyl derivatives of phenolphthalein can lead to a good yield of the desired alkyl derivatives *via* the intermediate formation of the diketo-derivatives. In this way we have prepared the following compounds :—

- (1) Diethyl phenolphthalein,
- (2) Dipropyl phenolphthalein, and
- (3) Dibutyl phenolphthalein.

Their constitutions have been confirmed by independent syntheses. It is noticed that the reaction described will be of interest as a general method for the preparation of other substituted alkyl derivatives of phenolphthalein.

213. Preparation of Alkyl fluoresceins.

AVDHESH NARAIN SRIVASTAVA and H. L. ROHATGI, Kanpur.

Some alkyl substituted fluoresceins were required in connection with some work undertaken in these laboratories, but a search of the literature has shown that excepting the diethyl and dihexyl fluoresceins prepared by Sandin and Sutherland (J.A.C.S. 1922, 51, 1773-75), no other alkyl substituted fluoresceins has been reported as yet. We therefore undertook the preparation of these compounds and have noted that suitable application of Fries reaction to the corresponding acyl derivatives of fluoresceins can furnish the intermediate diketo derivatives which on reduction by Clemmensen's method ultimately led to the desired alkyl fluoresceins in fairly good yield. In this way we have prepared the following compounds :—

- (1) Diethyl fluorescein.
- (2) Dipropyl fluorescein.
- (3) Dibutyl fluorescein.
- (4) Diamyl fluorescein, and
- (5) Dihexyl fluorescein.

The constitution of these compounds has been further confirmed through independent synthesis in each case and mixed melting points. The method developed is thus a general one for the preparation of any alkyl fluoresceins of the type mentioned above.

214. Chemistry of the products from *Ocimum kilimandscharicum*, Linn. (i) Camphoraceous essential oil and (ii) Chromatographic Examination of the Aminoacids from the non-fatty matter of its seeds.

V. G. SONAR and V. A. PATWARDHAN, Sangli.

Essential oil of the leaves of the plant, *Ocimum kilimandscharicum*, Linn. (Kapurtulas), was obtained by steam distillation and extracted with ether. The yield of the oil amounted to 0.5% on the fresh leaves and 2.5% on the air-dried leaves. The camphor content in the essential oil was found to be about 72%. The golden yellow coloured essential oil, having camphoraceous odour, gave the

following constants : Sp. gr. at 32°C., 0.9087; Refractive Index at 33°C. (Abbe), 1.4779; Acid V. 1.63; Sap. V. 8.13; M.P. of the crystalline substance obtained from the essential oil (camphor) 175°C. Higher yields of the essential oil (upto 5.5%) have been reported from Bangalore and Calcutta. The climatic and soil conditions seem to have appreciable influence on the yield of the essential oil.

(ii) The aminoacids obtained from the non-fatty matter of the seeds of the plant, after extraction of the drying oil, were studied by circular paper chromatography. The chromatogram showed the presence of the following amino-acids : Leucine, Phenylalanine, Valine, Tryptophan, Tyrosine, Alanine, Glutamic acid, Serine, Arginine, Histidine and Cystine. The chromatogram obtained similarly from the non-fatty matter of linseed, *Linum usitatissimum*, Linn., which yields the well known drying oil, showed the presence of the same amino-acids. Further work is in progress.

214A. A New Method of Preparation of Indole-3-aldehydes.

S. SWAMINATHAN and S. RANGANATHAN, Madras.

Snyder and co-workers (J. Am. Chem. Soc., 1952, 74, 5110) have converted certain Mannich bases of indole and substituted indoles to the corresponding aldehydes by reacting with a solution of hexamethylenetetramine in acetic or propionic acid. The reaction has been extended since to the preparation of 7-Azaindole-3-aldehyde (J. Am. Chem. Soc., 1955, 77, 457). One possible explanation for this conversion was the intermediate formation of the parent indoles by reversal of the Mannich bases and the subsequent reaction of these indoles with hexamethylenetetramine in a manner analogous to the Duff reaction (J. Chem. Soc., 1941, 547) or phenols with hexamethylenetetramine. This explanation was considered improbable in view of the finding that no indole-3-aldehyde could be obtained by reacting hexamethylenetetramine with a hot solution of indole in glacial acetic acid.

It has now been found, however, that indole-3-aldehyde could be obtained in 50 to 55% yield directly from indole under different conditions. In the new procedure, a solution of equimolar amounts of indole and hexamethylenetetramine in 66% acetic acid is added over a period of one hour to a refluxing solution of hexamethylenetetramine in 66% acetic acid, the reaction mixture diluted with water and the crude product collected and crystallised from hot water to give material with m.p. 189-192°. The same yields were obtained when the reaction was carried out in 66% propionic acid or 66% butyric acid. Under the same conditions, 2-phenylindole and 2-methyl-indole gave the corresponding 3-aldehydes in 99% and 25 to 30% yields respectively. The procedure described by Duff (loc. cit.) when applied to indole, did not give any indole-3-aldehyde.

214B. Study of the reaction of Hexamethylenetetramine with Gramine.

S. SWAMINATHAN and S. RANGANATHAN, Madras.

A study of the conversion of gramine to Indole-3-Aldehyde by reaction with hexamethylenetetramine has been made with a view to establish the course of the reaction. By reacting gramine methosulphate with hexamethylenetetramine either in aqueous solution or in chloroform-methanol solution, it was not possible to isolate Indole-3-Aldehyde or the postulated intermediate Sommelet salt. The reaction of gramine itself in specially dried acetic acid gave no trace of Indole-3-Aldehyde in contrast to experiments in which ordinary glacial acetic acid was employed. The formation of the Sommelet complex seemed unlikely and therefore it was of interest to determine if the reaction proceeded by initial hydrolysis of gramine followed by formulation as in the Duff reaction.

It was soon found that Indoles and substituted Indoles (see accompanying abstract) reacted with hexamethylenetetramine in 66% acetic acid to give varying yields of the corresponding Indole-3-Aldehydes. With a view to isolate Indole, if formed, gramine was alone refluxed in acetic acid under conditions in which it reacted with hexamethylenetetramine to give Indole-3-Aldehyde. From the reaction mixture was obtained 70-75% of unreacted gramine and a polymer but no Indole. The polymer must have been formed by reaction of Indole with formaldehyde which is also a product of hydrolysis of gramine. In fact Indole which by itself was stable in 66% acetic acid was found to give a polymeric material in presence of an equimolar amount of added formalin.

In order to obtain further evidence for the view that Indole-3-Aldehyde is formed from gramine via Indole formed *in situ*; the reaction of hexamethylenetetramine with 2-dimethylaminomethylindole was studied. This compound would be expected to give Indole-3-Aldehyde or Indole-2-Aldehyde depending upon whether Indole of the Sömmelét salt is the intermediate involved. The actual product, isolated in about 20% yield, was however 2-dimethylaminomethylindole-3-aldehyde (M.P. 49-52°). Apparently 2-dimethylaminomethylindole is more prone to formylation at the 3-position than hydrolysis under the conditions of the reaction. The above mechanism involving hydrolysis and formylation applies only to the conversion of the Mannich bases to aldehydes and does not hold good for the conversion of quaternary salts, such as benzylphenyl-dimethylammonium chloride, derived from amines other than Mannich bases.

215. Compounding of Perfumes.

J. N. TANDON and G. N. GUPTA, Kanpur.

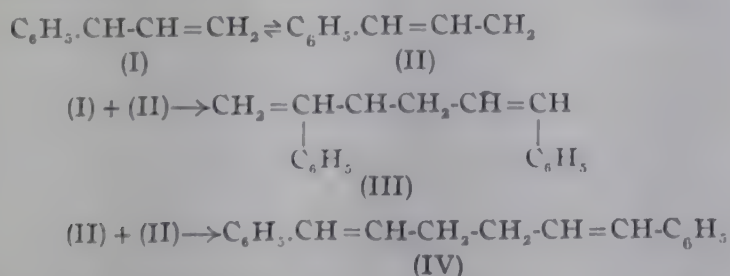
The art of compounding perfumes is a complicated one and requires an intimate knowledge of aromatic substances, the odour value of each and their character in blending in order to achieve the ideal results. The authors have given the details of preparation of *Kewda*, Lilac and Narcissus blends in a systematic manner giving bases, blenders, modifiers and fixatives, etc.

The prepared samples compare quite favourably with the imported samples.

216. Dimerisation of vinyl acetic acid to subercolic acid. A new example of allylic rearrangement in free radical reactions.

R. S. THAKUR and K. B. L. MATHUR, Delhi.

It is known that phenyl vinyl methyl radical (I) and cinnamyl radical (II) are readily interconvertible. Thus, when any one of them is generated in solution, the dimerised product consists of 1, 4-diphenyl hexa 1, 5-diene (III) and 1, 6-diphenyl hexa, 1, 5-diene (IV) :



In this paper is described a new example of this kind of rearrangement. Vinyl acetic acid (V) when interacted with acetyl peroxide is found to give subercolic

alkyl ethylenediamines. The latter were condensed with the required aldehydes at low temperature to obtain 1,2-substituted imidazolidines, which on treatment with ethyl chloroformate gave the required 1-alkyl-2-alkyl-3-carbethoxy imidazolidines.

Condensation of the amines with formaldehyde gave polymerised compounds which are under investigation.

219. Chemotherapy of Filariasis—Part II, Synthesis of some straight chain analogues of Hetrazan.

P. S. WADIA, NITYA ANAND and M. L. DHAR, Lucknow.

Some straight chain analogues of the piperazine filaricidal agent Hetrazan have been synthesized by the condensation of N-substituted dialkylamino ethylamine with ethyl chloroformate, diethyl-carbamyl chloride, phenyl isocyanate, and acyl chlorides, in presence of alkali.

219A. A neutral crystalline principle isolated from the flowers of *Ixora coccinea*, Linn.

P. GEORGE VARGHESE, Trivandrum.

Several constituents were isolated from the dried flowers of *Ixora coccinea*, one of them being a hydrolysable neutral principle which on purification by repeated crystallisation from ethyl acetate was obtained in the form of plates, melting at 257°C.

BIOCHEMISTRY

220. Processing Lucerne for Edible purposes.

B. ANANDASWAMY and W. B. DATE, Mysore.

A processing method has been worked out for preparing a fibre-free lucerne concentrate rich in protein, minerals and vitamins. It has been shown that a mere cold water extraction of fresh leaves gives a higher yield of nutrients than treating leaves with steam before extraction. Possibilities have been shown for using such a lucerne concentrate as such or along with other food ingredients in the form of a soup mix.

Rat feeding experiments have shown that lucerne concentrate when supplemented to poor South Indian rice diet at 2% level produces an appreciable increase in the growth of rats.

221. Studies on the nutritive value of diets supplemented with the Galactomannan Mucilage of the Seeds of *Caesalpinia pulcherrima* Linn.

G. S. BAINS, D. S. BHATIA and V. SUBRAHMANYAN, Mysore.

Mucilaginous polysaccharides, by virtue of their giving viscous aqueous dispersions, are finding increasing use as stabilisers and thickeners in foodstuffs and pharmaceuticals. It has been previously reported that the seeds of *C. pulcherrima* contain mucilaginous endosperm. The composition of the constituent parts of the seeds, the yield and nature of the mucilaginous polysaccharide have already been reported.

The present paper discusses the results of studies on the over-all nutritive value of diets supplemented with 1.5 and 3.0% of the mucilage of *C. pulcherrima* by the rat growth method. The levels of supplementation selected for the mucilage are the normal limits within which these materials may find use in foodstuffs.

No significant differences in the growth promoting value of the mucilage containing diets as compared with the control were observed. It has been further shown that incorporation of mucilage in the diet did not influence the 'apparent digestibility' of the carbohydrate, nitrogen and fat content of the diets. The nature of sugars contained in the faecal and dietary hydrolysates has been studied chromatographically.

222. A study of the properties of some fungal cellulases with particular reference to their inhibition.

S. N. BASU and P. N. PAL, Calcutta.

Cellulase activity in the culture filtrates of *Myrothecium verrucaria* and five jute-decomposing fungi grown on cellulose as carbon source was studied under various conditions using specially prepared reactive cellulose and carboxymethyl cellulose as substrates. Shaking of the assay medium partially destroyed the enzymes, unshaken flasks giving higher and equally concordant titres. The relative cellulolytic potencies of the enzyme extracts bore no relation to the relative cellulose-decomposing capacities of the fungi as previously determined. Maximum enzyme concentration in the medium was reached not earlier than 8 days' growth. No cellulose was produced using glucose or sucrose as carbon source. An acidic pH favoured cellulase activity but the optimum varied with the substrate. The optimum temperature was around 47°C. Cellulase in all filtrates was inhibited by heavy metals, p-chloro-mercuribenzoate and cystine, inhibition being reversed by cysteine and sodium sulphide, so that the presence of thiol groups essential for enzyme action is indicated. Acid dyes proved to be inhibitory, and basic dyes stimulatory, at low pH, while at higher pH levels the latter were inhibitory.

223. Preparation and Properties of Transfructosidase in Polianthes Tuberosa, Linn.

I. S. BHATIA, Mysore.

Polianthes tuberosa is the third fructosan-bearing plant in which the presence of a transfructosidase has been definitely established. The enzyme acts upon sucrose in the absence of added PO_4^{111} , forming glucofructosan and glucose. Properties of the enzyme obtained in a concentrated form by fractional precipitation of the juice of the tubers with ammonium sulphate are: optimum temp. 25°, pH 5.6 and sucrose concentration 30% for the enzyme action. No cofactors seem to be involved as the dialyzed enzyme is active. When raffinose is used as a substrate, only hydrolytic activity is observed.

224. Edible Syrup from Molasses.

K. G. BHATLA and S. MUKHERJEE, Kanpur.

Alcohol (90%-3 liters) was heated to 50°C and was poured under heavy stirring in the preheated molasses (60°C and 500 gms.) Suspended gums, pectins, and salts were allowed to settle. Alcoholic sugars solution was decanted and alcohol distilled off. The sugars solutions obtained was then treated with activated carbon,

before passing through ion-exchangers (Duolite C-3H and Duolite A-7). The results of the syrup obtained after deionisation and concentration are given below.

Brix	Pol.	Pol Purity	Sucrose%	Sucrose Purity	Invert sugar%	Ash Sulphated %
91.6	40.10	43.80	49.40	54.21	25.72	1.09

225. Studies on Vitamin A in Solution.

SUKHAMOY BHATTACHARYA and U. P. BASU, Calcutta.

Studies on the stability of vitamin A, in continuation of earlier work, have shown that vitamin A palmitate is equally stable in both oil and water. The addition of iron and copper to the vitamin A solution in vegetable oil (arachis oil) shows that irrespective of the chemical form, both these metals destroy vitamin A activity very rapidly, copper being more deleterious. Tocopherol was found to protect the activity to some extent while citric acid and propyl gallate individually kept the potency of vitamin A fairly well, the effect being slightly better in presence of iron than in copper.

The influence of antioxidants and metals on the stability of vitamin A in aqueous medium was therefore studied. An accelerated method for the destruction of vitamin A was followed in this investigation by heating at an elevated temperature (100°C) and the time for the loss of 50% activity was noted. Results show that vitamin A palmitate without any added adjuvant was most stable. Addition of tocopherol (0.1%) was of no advantage. Propyl gallate (0.05% and 0.3%) rather accelerated destruction.

Metals (iron and copper) in general help destruction of vitamin A, the chlorides being more deleterious than stearates. Contrary to the observation in oily preparations, propyl gallate (0.05%) in water dispersion does not deactivate the influence of iron salt while citric acid (0.1%) in the system containing iron stearate accelerates the destruction to a great extent.

226. Chromatographic Studies of Yeast Invertase.

M. M. BISWAS, Calcutta.

Dry aluminium hydroxide (3 parts) and finely powdered quartz sand (1 part) were mixed together and lightly stamped into chromatographic tubes (10 c.m. x 2 c.m.) to a height of 5 c.m. 10 c.c. of acetate buffer of pH 5.4 was allowed to pass through the column under slight suction followed by 25 c.c. of yeast extract. The chromatographic column was extruded and shaken with 25 c.c. N/10 ammonia for 15 minutes in a centrifuge tube. After the addition of 25 c.c. water it was centrifuged and then washed with 50 c.c. water in the centrifuge tube for 10 minutes twice. The combined solution (150 c.c.) was centrifuged again for 30 minutes to eliminate turbidity. The composition of the adsorption column was varied and the ratio of enzyme activities in the filtrate and eluate was also found to vary. A column of 100 mesh aluminium hydroxide (3 parts) and 40 mesh sand (1 part) gave a filtrate which was found to contain about 80 per cent of total saccharase of the yeast extract.

227. Studies on Orange (Tangerine) Juice.

A. N. BOSE and J. M. DUTT, Calcutta.

Properties of orange juice, with particular reference to those of importance in preservation industry have been studied. Orange (tangerine) from Nagpur area, was

studied. The juice was found to be of best flavour when sugar to the acid ratio (maturity index) was 10 to 12. Ascorbic acid content of the juice normally increases till the maturity index is near about 12. The amount of ascorbic acid in normal juice of maturity index 12 was found to be 45.5 mg. per 100 c.c. of the juice on the average. Of the total sugar, nearly 50% was found to be sucrose. There is simultaneous increase of sucrose and reducing sugar with increasing maturity. Specific gravity, expressed in degrees Brix, was found to be 12 for the juice with optimum flavour. On the average 0.413 litres of juice were obtained per one kilogram of the fruit.

228. Significance of multiple pathways in adaptation. II Inhibition of germination of *Aspergillus niger* as induced by exposure to phenylmethane dyes.

S. K. BOSE, Calcutta.

The pattern of delay induced in the germination of *Aspergillus niger* by previous exposure to phenylmethane dyes indicates that multiple mechanisms are involved in the process. These multiple pathways may be intrinsic virtues or potentialities for adaptation.

229. Tracer Studies in Citric Acid Fermentation by *Aspergillus Niger*—I. Role of CO_2 under conditions of Industrial Fermentation.

M. DADMODARAN, P. K. BHATTACHARYYA, J. R. VAKIL and
A. K. DAS GUPTA, Poona.

It has been demonstrated by different groups of workers in the last decade that appreciable amounts of atmospheric CO_2 are fixed in the citric acid produced by *Aspergillus niger*. In the present investigation the quantitative aspects of the incorporation of atmospheric CO_2 in citric acid under conditions of industrial fermentation using a high-citrate yielding strain of *A. niger* in surface cultures are being studied.

The mould was grown on a modified Curries' medium containing glucose or sucrose in an enclosed system with C^{14}O_2 at 28-29°C. On glucose, citric acid production reached a maximum in 8-10 days, while on sucrose medium containing high concentrations of zinc, maximum yields were obtained in 7-8 days. Yields of citric acid (citric acid monohydrate g./100 g. of available sugar) in these experiments ranged up to 73%.

It was found that up to 60% of the radioactivity of the initial CO_2 was incorporated in the fermented medium. Citric acid, which in most cases accounted for almost all the radioactivity in the medium, was isolated as the quinidine salt and degraded chemically to determine the amount and distribution of the radioactivity in the carboxyl carbons. The carboxyl carbons were found to contain practically all the radioactivity of the citrate. The ratio of the radioactivity of the primary and tertiary carboxyls was found to be slightly greater than 1, indicating that a high degree of equilibration might have taken place among the four-carbon dicarboxylic acids before they were condensed into citrate.

It was estimated that 7 to 14% of the total carbon in citric acid was derived from atmospheric CO_2 (Theory—16.7%).

The usual fermentation period was divided into three time-periods:—0 to 5th day, 5th to 7th day and 7th to 9th day, and the incorporation of C^{14}O_2 in citrate was studied for each period. The results of these experiments are discussed in relation to the mechanisms involved in citrate synthesis.

230. Amino Acid Composition of some common Indian vegetables as determined by Paper Chromatography.

S. GHOSH MAJUMDER and N. C. GANGULI, Calcutta.

A complete analysis of amino acid contents in some twenty-five varieties of common Indian vegetables was made applying quantitative paper chromatography. About 12 amino acids such as Leucines, phenylalanine, valine, γ -aminobutyric acid, tyrosine, β -alanine, threonine, glutamic acid, serine, aspartic acid, cystine and proline were found to be present in almost all the samples analysed. Amongst twentyfive samples analysed, about 14 samples were found to be good sources for essential amino acids. From nutritional standpoint, spinach, tomato, onion, onion stalks, drumstick, cabbage and neem tender can be selected as good sources for both essential and non-essential amino acids.

231. Studies on the Production of Vitamin B₁₂ by *Streptomyces olivaceus*.

SUBRATA GANGULY and S. C. ROY, Calcutta.

The production of vitamin B₁₂ by a strain of *Streptomyces olivaceus* NRRL B-1125 has been investigated, using a variety of indigenous protein sources—both of vegetable and animal origin. It has been observed that *Shrimp* powder, if used as the source of nitrogen gives yield of vitamin B₁₂ quite comparable to that obtained with Distiller's dried solubles used in other countries particularly in America. Soybean meal supplemented with peptone-like materials was also quite satisfactory. The results obtained in the rotary shaker have been satisfactorily reproduced in a semi-large fermentor.

232. Studies in Oxidation of Vitamin C by Hypophosphorous Acid.

P. N. JOSHI and GHASASI, Poona.

It was found that hypophosphorous acid considerably increases the rate of oxidation of vitamin C at acid pH. This oxidation is inhibited by diethyldithiocarbamate. 8-Hydroxyquinoline, cysteine and histidine are however unable to protect vitamin C. The rate of oxidation is proportional to the concentration of vitamin C and hypophosphorous acid.

233. Isolation of highly purified 'Thromboplastic Protein' from beef lungs.

N. R. KALE and P. N. JOSHI, Poona.

Saline extract of fresh beef lungs after treatment with carbontetrachloride at 0°C, was deprothrombinised by treating it with a small amount of Al(OH)₃ gel. On saturating this solution with sodium chloride at 0°C, it was observed that 50-60% of the active protein was precipitated, leaving behind a lot of inactive protein and colouring matter. The precipitate was suspended in water and treated with small lots of bentonite to remove inert proteins. The process was repeated till there was no considerable fall in the TPLN activity. After bentonite treatment the extract was repeatedly passed over chromatographic alumina column till the protein concentration was reduced to 1 mg./c.c. The extract was then mixed with a small amount of activated charcoal and kept at 50°C for 5 mins. Afterwards it was centrifuged and dialysed to remove excess of sodium chloride and other dialysable impurities. During these operations only 20% of the total activity was in hand but specific activity was increased from 7.8 to 64.29.

The preparation thus obtained is a protein free from phosphorous and devoid of phosphatase as well as proteolytic activity. It is stable upto 60°C. but cannot be fractionated by $(\text{NH}_4)_2\text{SO}_4$, Na_2SO_4 , CH_3COONa , etc. However, it can be concentrated by precipitating at its isoelectric pH, 4.1, by means of veronal buffer of low ionic strength at 0°C and redissolving it in veronal buffer of pH 6.99. Further characterization of thromboplastin protein by electrophoresis, chromatography and fractionation methods is under investigation.

234. Production of Amylase in Laboratory-scale Fermenter.

BHAGWAN S. LULLA and DYAL SINGH JOHAR, Mysore.

To evolve an economical medium for the large-scale production of amylase, studies were conducted in utilizing spent wash liquor, a distillery by-product for the growth of *Aspergillus oryzae*. The spent wash obtained from the Mysore Sugar Factory, Mandya, was poor in nitrogen content. The growth of *A. oryzae* on this material was unsatisfactory but supplementation of this medium with KNO_3 gave higher amylase activity. The toxicity of spent wash was considerably reduced by diluting it with water. The supplementation of diluted wash with ammonium sulphate gave higher amylase activity as compared to synthetic medium and much lower activity as compared to bran medium.

Among the various molds investigated, *A. oryzae* (CFTRI 1021) yielded maximum amylase activity on wheat bran extract. Mold growth obtained from the fermenter can be repeatedly used as inoculum for subsequent batches. Contamination is largely controlled by the use of penicillin and formalin in the culture medium. The mold growth obtained as a by-product in this process was found to contain 66% protein and 6.8% fat on dry basis.

235. Synthesis of Riboflavin by *Ermothecium ashbyii*.

BHAGWAN S. LULLA and DYAL SINGH JOHAR, Mysore.

Ermothecium ashbyii was grown on a semi-solid medium and the formation of riboflavin on 8th day was determined. Among different raw materials tried, wheatbran yielded maximum riboflavin in the medium. Addition to this medium of 0.2 g. of peptone, singly or with 0.2 g. of yeast extract lowered the production of riboflavin. The optimum ratio of bran to water for maximum riboflavin production was 1:1.5. The vitamin production was further increased when bran material was diluted with phosphate buffer instead of water. The riboflavin concentrate was prepared by growing the organism in 4 liter wide-bottomed culture flasks containing 150 g. of wheat bran medium for 10 days at room temperature. The riboflavin from the medium was extracted with acid-alcohol mixture and the extract concentrated. The material on analysis gave 5.6 mg. of riboflavin per gram of the preparation.

236. Lactones and Metabolism of certain Plant Tissues : "Influence of δ -Hexenolactone and α - β -Angelicalactone on some phases of metabolism of (i) Pea-stem sections and (ii) Potato slices." Part I and Part II.

C. M. MEHTA, Baroda.

The influence of δ -hexenolactone and α - β -angelicalactone has been separately studied on the growth and on the respiration of tissues of pea-stems and potato slices. Both lactones at $5 \times 10^{-4}\text{M}$, $5 \times 10^{-4}\text{M}$, $5 \times 10^{-3}\text{M}$ and $5 \times 10^{-2}\text{M}$ inhibited the growth of both tissues. The inhibition of growth was accompanied by an

increased loss in dry weight partly due to diffusion and partly due to respiration. The study of O_2 uptake ($\mu l O_2$) and CO_2 output ($\mu l CO_2$) during the periods of 1-4 hour and 16-20 hour at 20 minute intervals indicated that the respiration of pea-stems has been inhibited at $5 \times 10^{-4}M$ and $5 \times 10^{-3}M$ of each lactone compared to water control. A small decrease in the RQ of pea-stems observed with each lactone suggests a slightly diminished utilization of carbohydrate and a mobilization of protein or fat. In case of the potato-tissue respiration, both lactones at $5 \times 10^{-5}M$, $5 \times 10^{-4}M$, $5 \times 10^{-3}M$ have been found stimulatory rather than inhibitory; the O_2 uptake ($\mu l O_2$) and CO_2 output ($\mu l CO_2$) at 30 minutes interval are stimulated by weak lactones, less so by stronger ones during 1-8 hour period; whereas, O_2 stimulated and CO_2 depressed during 22-30 hour, when the material being studied after keeping it for 24 hours in water at (i) room temperature and (ii) in the refrigerator. In each condition striking decrease in the RQ takes place either with stronger lactone or in the latter stage with weaker lactone suggesting the equilibrium, $Fat \rightleftharpoons Carbohydrate$ (or acid), is shifted to the right at high HL or AL concentrations, and soluble compounds thus formed diffuse away in making cell-walls and membrane more permeable. The difference in behaviour of potato tissue with some disproportionation of the balance of enzymes concerned in carbohydrate metabolism.

237. Behaviour of cooking on the bound nicotinic acid of the pure-bred strains of rice.

B. R. MITRA and D. K. CHAUDHURI, Calcutta.

In this paper studies on the effect of cooking under different conditions on the nicotinic acid values of the pure-bred strains of rice have been made. The main points in these studies are

- Estimation of the bound and the total nicotinic acid content after extraction with dilute acid.
- Estimation of the bound and the total nicotinic acid content after cooking with distilled water.
- Estimation of the bound and the total nicotinic acid content after cooking with tap water.

From the results obtained in (a) it may be said that the rice samples contain almost all the nicotinic acid in the bound state. While the results obtained in (b) indicate that some portion of the bound nicotinic acid is drained off along with the gruel after cooking with distilled water, pH of which is about 6.6, almost all the nicotinic acid left in the cooked rice after this treatment is still in the combined form. In the final studies (c) it has been observed that some of the nicotinic acid is washed away with the gruel after cooking with tap water and a portion of the bound nicotinic acid is decomposed liberating free nicotinic acid. It is suggested that the tap water which has an alkaline pH of about 8.4 decomposes some bound nicotinic acid and the equivalent amount of nicotinic acid is liberated free.

238. Some Observations on the Influence of Pitching Rate in Alcoholic Fermentation.

K. K. MITRA, Calcutta.

An overall kinetic picture of the attenuation process as influenced by the pitching rate through a wide range (3 to 24 mg. of moist yeast per ml.) has been presented and analysed. The major effects of the increasing pitching rates are in the shortening of the lag phase and an earlier attainment of the limit of attenuation. Experimental results on the metabolism of sugar with varying pitching rates

show that even through a very wide range of yeast concentration (20 to 75 mg/ml) a linear relationship can be demonstrated by proper adjustment of the experimental conditions. To reveal such a relationship, the measurement of sugar metabolism should be conducted at a stage when all the reaction mixtures with different pitching rates are passing through the logarithmic phase of fermentation. Adequate precautions have also to be taken to eliminate the growth of yeast during the period of incubation in order to demonstrate such a linearity through the wide range of pitching rate. Emphasis has been laid on the need for precise statement of the experimental conditions for proper evaluation of the results in such studies.

239. Milk Substitute from Solvent Extracted Groundnut.

M. N. MOORJANI and D. S. BHATIA, Mysore.

The vegetable milk as prepared from the groundnut by the method previously reported by the authors still retains some nutty flavour reminiscent of groundnut. With the object of preparing a milk substitute completely free from groundnut flavour, the present investigation was undertaken taking solvent extracted groundnut flour as the raw material. The groundnut flour was prepared by partial removal of oil from groundnut in a hydraulic press followed by alcohol extraction of the residual oil. The extracted meal was finely powdered in a mikropulverizer. 58 parts of the groundnut flour were blended with 42 parts of refined groundnut oil containing 0.01% of ethyl gallate. The paste thus obtained was subsequently converted into emulsion by addition of water to give 8 pounds of emulsion for every pound of paste. Lecithin (0.06% on milk basis) was used as the emulsifier and the milk substitute as adequately fortified with mineral and vitamin supplements.

The milk thus prepared was considered more acceptable than that prepared by starting with the whole groundnut kernel and converting its solids into emulsion.

Effect of various solvents and heat treatment on the quality of protein of the cake used for experimental work is also described in the present investigation.

240. Changes in the Free Amino Acid Composition of Some Pulses during Germination.

D. L. NANDI, N. C. GANGULI and S. C. ROY, Calcutta.

The changes in the free amino acid composition of *Lens esculenta*, *Vigna catiung*, *Phaseolus mungo* and *Cicer arietinum* at different stages of germination were studied with the help of paper chromatography. Considerable increase in number and concentration of free amino acids in seeds germinated in water media was found to take place in the case of *Lens esculenta*, *Vigna catiung* and *Cicer arietinum*, but not with *Phaseolus mungo* during the progress of germination. Asparagine was the predominating amide appearing with striking increase in concentration with germination of these four varieties of pulses. In *Lens esculenta* the number of free amino acids increased from 10 to 24, while with *Vigna catiung* and *Cicer arietinum*, the increase is from 7 to 16 and 9 to 12 respectively. But with *Phaseolus mungo* such change was not observed.

241. Prevention of Alloxan Diabetes in Rabbits by a Condensation Product of Glucose and Acetoacetate and Its Mechanism.

M. C. NATH and E. P. M. BHATTATHIRY, Nagpur.

The condensation product of glucose and acetoacetate in the form of its Na salt can completely prevent alloxan diabetes in 50% of the rabbits when injected

intravenously five minutes before the diabetogenic dose of alloxan, in the molecular proportion of 0.5:1 only. The percentage of such prevention increases with the increase in the proportion of the condensation product. 1:2 dienol glucose prepared from different sources combines with alloxan *in vitro* at pH 7.2 even in the absence of any added enzyme.

Blood urea and alkaline phosphatase of plasma, which rise in alloxan diabetes, are within the normal limits in all the animals showing prevention of alloxan diabetes.

Endiol glucose, which can be liberated from the condensation product combines with alloxan both *in vitro* and *in vivo* to give rise to a non-diabetogenic compound-alloxanic acid. It is through this mechanism that alloxan diabetes is prevented by endiol glucose or its precursors. Alloxantin may be formed in certain proportion. Formation of alloxanic acid during the reaction between endiol glucose and alloxan has been confirmed by showing the formation of urea in the reaction mixture, which is a breakdown product of alloxanic acid.

242. Nutritive Value of Shark Liver Oils.

S. K. PRADHAN and N. G. MAGAR, Bombay.

Waghbeer shark liver oil was administered to young albino rats at 5, 10, 15 and 20 per cent level with vitamin A equalised in all the groups. Growth and food intake were noted for 4 weeks. The average growth of rats on 5 per cent level of Waghbeer liver oil was found to be better than that of others. Rats on 15 and 20 per cent level lost their weights during the experiment. Liver and muscle tissues of rats from the different groups were analysed for moisture, fat and protein content.

Three shark liver oils—Khada, Pisori and Win—were compared with hydrogenated fat at 5 per cent level from the average gain in weight for 5 weeks in young rats. It was observed that the growth of rats on Khada and Pisori liver oils was almost the same to that of hydrogenated fat. Win oil showed lower growth. Blood and soft tissues have been examined for lipid P, cholesterol, lecithin and sphingomyelin. Lipid P was higher in liver and brain in shark liver oil rats.

243. Vitamin D in Shark Liver Oils.

S. K. PRADHAN and N. G. MAGAR, Bombay.

Liver oils from four different species of sharks were analysed biologically for their vitamin D content using albino rats, fed rachitogenic diet. When the weights of the rats plateaued, the rickets were confirmed by X-rays. Two groups of nine rats each, were given 5 and 10 units of standard reference vitamin D and other groups 1 ml. of different shark liver oils daily. The animals were killed on the tenth day for the 'line test' and ash, Ca and P of radius and tibia respectively. The results of calcification were calculated graphically from the area of calcification and the log of the dose of standard vitamin D.

Green's chemical method was compared with the biological method. It was observed that the chemical method could not be applied to shark liver oils which were found to contain 5-10 I.U./g. vitamin D biologically. 'Dara' and 'Ghol' (not belonging to elasmobranch), however, contained 1300 and 300 I.U./g. of vitamin D.

244. Production of Itaconic Acid by Fermentation.

(Miss) V. RADHA and K. RAMACHANDRAN, Hyderabad-Dn.

The production of itaconic acid in pilot plant quantities by fermentation methods has opened up possibilities of utilising it in the resin and plastic

industries. The authors have studied a number of strains of *Aspergillus terreus* and have confirmed that NRRL 1960 and NRRL 265 are the most useful for this fermentation, the former being superior to the latter. In a medium containing 15% cane sugar and mineral salts with low phosphate content and an initial pH of 2.9, upto 45% yields of itaconic acid on the sugar consumed have been obtained using N.R.R.L. 1960. Optimal conditions for this fermentation in stationary culture are described. The effects of addition of iron, zinc, molasses, primary alcohols etc., to the medium, on the yields obtained are described. Further experiments with molasses are under way. A pilot plant is under construction.

245. The Influence of Amino-Acids on the Auto-Oxidation of Ascorbic Acid.

P. C. RAKSHIT and P. BHATTACHARYYA, Calcutta.

The auto-oxidation of ascorbic acid solutions was studied in presence of different amino-acids, like glycine, alanine, glutamic acid, aspartic acid, leucine etc. and amides like asparagine, guanidine. When these compounds are present in molecular proportions to ascorbic acid or in higher proportions they exhibit a strong inhibitory influence on the auto-oxidation. The amino-acids suffer no chemical change. The inhibitory action decreases with increase of temp. and pH. It is suggested that inhibition is probably due to a kind of loose association with ascorbic acid.

246. Detection of Glyoxylic Acid in Glucose Oxidation by *Pseudomonas fluorescens*.

K. RAMACHANDRAN, Hyderabad-Dn.

Strains of *Pseudomonas fluorescens* oxidised glucose to gluconate and to 2-Ketogluconate both in stationary and agitated cultures. The yields of 2-Ketogluconate never exceeded 50% in stationary cultures, whereas under aeration yields of 80% and over were obtained. Very little or no gluconate as such was present in the cultures at any time as the rate of gluconate oxidation was very rapid. α -Ketoglutaric acid was detected in aerated cultures, but not in stationary cultures. Glyoxylic acid was detected both in stationary and aerated cultures, in addition to pyruvic acid. It may represent the two-carbon fragment or be derived from it, if it is presumed that 2-Ketogluconate or a 5-carbon molecule may split into fragments of two or three carbons, in the culture medium.

247. Formation of α -ketoglutarate by *Aspergillus Terreus*.

K. RAMACHANDRAN and (MRS.) SHYAMALA RAO, Hyderabad-Dn.

In the course of investigations into the mechanism of formation of itaconic acid by *Aspergillus terreus* it has been found that considerable amounts of α -ketoglutaric acid accumulate in the culture media when itaconic acid-producing strains of the mould are allowed to develop on a sucrose-salts medium at a pH of 2.9. More α -ketoglutaric acid is formed by N.R.R.L. 1960 than by N.R.R.L. 265 and under the experimental conditions employed the former also produces more itaconic acid than the latter. Determinations of the α -ketoglutaric acid formed have been made and it is shown that upto 225 mg. of the keto-acid are present in 100 ml. of the culture solution of N.R.R.L. 1960, originally containing 15 g. of sucrose after 16 days of incubation. The significance of this accumulation in the light of the currently-held views on the mechanism of formation of itaconic acid is discussed.

248. Keto-acid Formation in Mould Cultures.

K. RAMACHANDRAN and (MRS.) SHIYAMALA RAO, Hyderabad-Dn.

The formation of α -ketoglutaric, pyruvic and dimethyl pyruvic acids by strains of *Aspergillus niger* and *Penicillium chrysogenum* has been reported by several workers. Ramachandran and Radha (*Current Sci.*, 1955, **24**, 50) demonstrated the formation of these keto-acids from several substrates by strains of *Aspergillus terreus*, *A. Wentii* and *A. oryzae*. The authors have extended these investigations further and show that these keto-acids, especially α -ketoglutaric and pyruvic are accumulated by the mould ((NRRL 255 strain of *A. terreus*) in the presence of carbonyl-binding reagents such as semicarbazide, hydrazine and sodium sulphite. Sodium arsenite, (which presumably acts by inhibiting the carboxylase system), in 0.01 M concentration is more effective, however, in accumulating keto-acids than any of these carbonyl-fixing reagents in 1% solution. The keto-acids were identified by paper chromatography of their 2:4-dinitrophenylhydrazones.

249. Production of Citric Acid from Cane Molasses.

K. RAMACHANDRAN and S. H. ZAHNER, Hyderabad-Dn.

Citric acid is being produced in increasingly large quantities by "fermentation" methods in several countries. Reports in literature show that sugar or beet molasses is successfully employed for this fermentation. The satisfactory utilisation of cane molasses for this purpose does not appear to have been achieved on a large scale. The authors selected a strain of *Aspergillus niger* from fifteen others and studied the conditions under which this produced 60% yields of citric acid from cane sugar. Later experiments were carried out with cane molasses and it was found that diluted molasses would ensure a vigorous growth of the mould, but with little citric acid formation. Treatment of the molasses with ferrocyanide and phosphoric acid and supplementation of the treated molasses with calculated amounts of mineral salts resulted in the production of citric acid, upto about 30% (weight by weight) on the sugar consumed. Molasses treated with ion-exchange resins (both cation- and anion-exchange or only cation-exchange) and with added salts gave 35% yields of citric acid. The maximum yields were obtained at pH 6. Reduction of pH lowered the yields. Addition of 1% methanol increased the yield by 30% over control, while 1% ethanol increased it by 10%. Pilot plant trials are under way.

250. Biosynthesis of Sucrose in Sugar Cane Leaves.

C. V. RAMAKRISHNAN, Baroda.

Cell free extracts of sugar cane leaves have been shown to contain an enzyme, sucrose phosphorylase, necessary to catalyse the synthesis of sucrose from Glucose-1-phosphate and fructose. It appears that this sucrose phosphorylase is different from starch phosphorylase.

251. The Binding of Zinc and Cadmium Ions by Native and Modified Bovine Serum Albumins.

M. S. N. RAO and HIRALAL, Poona.

The binding of zinc and cadmium ions by native and modified bovine serum albumins has been studied at pH 6.5, in an acetate buffer of ionic strength 0.2.

An equilibrium dialysis technique was used, the concentration of free metal ions at equilibrium being determined by polarography. The results indicated that the native albumin had a somewhat greater affinity for zinc than for cadmium ions and that, under the conditions studied, there were two sets of available sites on the albumin molecule, a first consisting of two and a second of sixteen sites. Whereas the nature of first set of sites is not yet clear, the second set probably consists of the sixteen imidazole groups of the histidine residues in the albumin molecule. The results of experiments, wherein the albumin competes with externally added histidine for binding the metal ions, lend further support to these conclusions.

Acetylated serum albumin in which 83% of the free amino groups of the protein were blocked, showed greater ability for binding zinc and cadmium ions due perhaps to the increased negative charge on the protein molecule. Methoxylated serum albumin in which all the free carboxyl groups of the protein were blocked, however, showed distinct differences in its behaviour towards zinc and cadmium ions. Thus, whereas, the binding of zinc ions by serum albumin remained unaffected by esterification of the free carboxyl groups of the albumin molecule, that of cadmium ions was much reduced. These results suggest that, for binding cadmium ions, the albumin molecule must have free carboxyl groups, possibly in suitable juxtaposition with the imidazole groups of the histidine residues. This condition did not seem to be necessary for binding zinc ions. The effect of the binding of zinc and cadmium ions on the electrophoretic mobility of the native and modified serum albumins should throw further light on the subject.

252. Absence of Inositol in Fungal alpha-amylase.

DURLAV K. ROY, Calcutta.

Williams and his co-workers reported the presence of inositol in purified pancreatic amylase. Fischer and Bernfeld and a number of other workers including Schwimmer, Bells and Caldwell did not corroborate this finding with purified amylase preparations from various sources. In the present investigation microbiological assay technique for determination of inositol in crystalline alpha-amylase from culture filtrate of *Aspergillus oryzae* as carried out using *Saccharomyces carlsbergensis* No. 4228 as the test organism. Crystalline fungal alpha-amylase was hydrolysed with dilute acid and the hydrolyzate was added in increasing doses to a synthetic medium (Modification of Atkin, Schulz, Williams and Frey). Turbidity of the growth of the *Saccharomyces* in the above medium was compared to that produced in the medium containing increasing doses of pure inositol. It was observed that the medium containing increasing doses of amylase-hydrolyzate did not show any greater turbidity than the control one without added hydrolyzate or inositol. This tends to prove that crystalline fungal alpha-amylase does not contain any inositol in the molecule.

253. The Study of Vitamin C of Some Fruits and Vegetables of Darjeeling.

SATYA RANJAN SARKAR, Darjeeling.

The paper deals with the study of the estimation of vitamin C of the following fruits and vegetables *c.g.* Granadilla (*Passiflora Edulis*), Churi (*Bassia Butyracea* Rox), Naspati (Pears), Peach and green Chillies. In most cases the samples are examined after one or two days of plucking.

Churi (*Bassia Butyracea* Roxb): The vitamin C content of the above fruit (e.p. ripe) is found to vary from 26.6 to 35.9 m.g./100 gms.

Granadilla (*Passiflora Edulis*): The vitamin C content of the above fruit (e.p. green) is found to vary from 19 to 29.5 m.g./100 gms. and the fruit (e.p. ripe) varies from 33 to 49.4 m.g./100 gms.

Naspāti (Pears) : The vitamin C content of the above fruit varies from 3.7 to 7.3 m.g./100 gms.

Peach : The vitamin C content of the above fruit varies from 3 to 3.7 mg./100 gms.

Green Chillies : The vitamin C content of the green chillies (long type) is found to vary from 11.4 to 220.7 m.g./100 gms. while of the flat type varies from 81.9 to 148.7 m.g./100gms. Chillies having red skin are found to contain more vitamin C than those having green skin. The vitamin C contents of the Naspāti, Peach and green Chillies of Darjeeling area are found to have higher values than those of Coonor in South India.

254. The Study of Vitamin C of Tomato and Tree Tomato of Darjeeling Area.

SATYA RANJAN SARKAR, Darjeeling.

The estimation of vitamin C in tomatoes and tree tomatoes of Darjeeling area has been carried out. The samples are examined one or two days after plucking. The vitamin C content of tomato (green) is found to vary from 6.9 to 19.5 mg., not fully ripe 12.9 to 21.5 mg., fully ripe 11.7 to 30.7 mg./100 gm. From the study it is seen that the ripe ones from whatever place they are collected contain more vitamin C than the green ones, and those which are not fully ripe contain slight higher vitamin C. Another finding is that the samples which are obtained from closeby places at the altitude of about 5,000 ft. and which are quite fresh contain less vitamin than those which are obtained from lower altitudes. It was also found that the vitamin C content of tomatoes as found in Coonor is higher than those of Darjeeling area, whereas the figures for tree tomatoes of Darjeeling are quite high when compared to Coonor variety.

255. Investigations into the Dietary Habits of the Aboriginal Tribes of Abor Hills (North-Eastern Frontier). Part II Minyong and Pangl Tribes.

P. N. SEN GUPTA, Calcutta.

Dietary and nutritional investigations were carried out in 310 families of Minyongs and Pangl tribes of Abor hills in 1949-50 and 1952. Economic status, living conditions, food sufficiency, consumption of calories and food groups, preparation of Abor beverage *Apong* and medicinal cake *seca*, festivals connected with food production, vital statistics, deficiency diseases and growth of the children in relation to their nutrients usages were also investigated. Paddy and Annyat (*coix lachryma*) are the main cereal crops respectively in the lower and higher regions. *Apong*, prepared by mild fermentation of the millet *mirung* (*Eleusine coracana*) with the help of *seca*, is of great importance in the social and religious lives of the tribes as well as to provide considerable nutrition. Besides Balek group of villages in the lower regions which produce adequate rice by wet cultivation, following are the average percentages of families receiving adequate nutrients: calorie—35.6%, protein—36.8%, calcium—11.5%, vitamin A—10.7%, thiamine 59.3%, riboflavin—5.0%, niacin—75.2% and vitamin C—10.0%. Due to short supplies of cereals, vegetables and flesh foods and not getting regularly *apong*, the Minyongs and Pangis in comparison with the Padams are ill fed and ill nourished. Consequently the Minyong boys have less gain in weight than the Padam boys.

256. Artificial Production of Tumours and Their Biochemical Basis.

ARUN KUMAR SHARMA and (Miss) BIBHA BHATTACHARYYA, Calcutta.

Tumour has been induced in root tips of *Allium cepa* following Colchicine, β Naphthyl acetic acid, α Naphthalene acetic acid, α Naphthyl acetic acid, Succinic

acid + a Napthalene acetic acid, Thiamine + a Napthalene acetic acid, treatments. Arginine reaction has been performed in the tumours and an increased rate of reaction has been found to be the case in all.

The roots of fresh bulbs have further been treated with three chemicals, namely, Succinic acid, Nicotinic acid and Thiamine and phosphatase reaction has been performed in the root tip tissue. An increase in phosphatase activity here too has been recorded.

257. A Study of the Cytology of Some of the Members of Hydrocharitaceae as an Aid to Trace the Lines of Evolution.

ARUN KUMAR SHARMA and (Miss) BIBHA BHATTACHARYYA, Calcutta.

The cytological investigation of four different species of Hydrocharitaceae has been carried out. The species are the following: *Hydrilla Verticillata*, Casp., *Vallisneria Mspiralis*, Linn., *Ottelia alismoides*, Pers., *Lagarosiphon Roxburghii*, Benth.

Paradichlorobenzene, Oxyquinoline and Aesculine method have been taken advantage of for a detailed study of the karyotypes of all of them. The normal somatic chromosome number found in case of *Hydrilla verticillata* is 24, in *Vallisneria spiralis* type I is 30 and in type II is 40, in *Ottelia alismoides*, is 48 and in *Lagarosiphon Roxburghii* is 100. The number of secondary constrictions noted in *Hydrilla verticillata* is four, in *Vallisneria spiralis* is ten, in *Ottelia alismoides* is eight (from 52 chromosome plate) and in *Lagarosiphon Roxburghii* is fourteen.

Variations in the chromosome number in nuclei with different body cells of the same individual have been reported. Such variations have been found to be occurring at random. This has been recorded in all the four species investigated.

The role of polyploidy associated with some structural changes of chromosomes in the evolution of species has been discussed. In view of the previous reports on a number of other families and the suggestions thus put forward, the significance of the presence of such abnormal nuclei in the somatic tissue has been discussed. In view of considering sexual means as a less efficient mechanism of reproduction than the vegetative means in the family, such variation has been considered as possibly providing a means for the origin of new forms. This may be achieved by their entrance into the growing tip of the runner and thus giving rise to young plants with altered chromosome complements.

258. Effect of Inositol and Molybdic Acid in Somatic Nuclei of Plants.

ARUN KUMAR SHARMA and (Miss) BIBHA BHATTACHARYYA, Calcutta.

The present report deals with induction of division in adult nuclei of plant cells through Inositol and Molybdic acid treatment. It has been noted that induction can be brought out in different concentrations, varying the period of treatment. In addition to division in adult nuclei, somatic division too has been initiated in normal diploid cells. It has been suggested that both these phenomena, that is induction and reduction of division, are two aspects of a disbalance in a single step in plant metabolism. On the basis of the present data and previous evidence, a change in the nucleic acid content of the cell is considered to be caused following such treatments. The normal diploid cells having already full quota of nucleic acid are induced to divide reductionally, while the normal adult differentiated cells being already deficient in this chemical, start dividing under conditions of treatment.

259. Effect of Chemical Treatment on Floral Shoots.

ARUN KUMAR SHARMA and (Miss) BIBHA BHATTACHARYYA, Calcutta.

In the present paper effects of Coumarin, Salicin and Aesculin have been investigated on the reproductive cells of *Foeniculum vulgare*, Gaertn. The treatment has been performed mainly through injection method and the effects have been noted after twenty four to forty eight hours of treatment.

The maximum frequency of irregularities has been noted following Coumarin application. Of all the irregularities, reductional separation of chromosomes, i.e. movements of two members of some of the bivalents to one pole and some to the other, as well as lagging and early separation are common in all of them. The cause has been attributed to the nucleic acid disbalance of the treated tissue.

260. Cytogenetics of Some Members of Menispermaceae.

ARUN KUMAR SHARMA and NRIPENDRA K. BHATTACHARYYA, Calcutta.

A cytological investigation of four different species of the family Menispermaceae distributed under four genera has been worked out. Of the species investigated, the diploid number *Cocculus villosus*, *Tiliacora racemosa* and *Tinospora cordifolia* have been found to be twenty-six and that of *Stephania hernandifolia* twenty-two.

The karyotype of the species shows considerable similarities in their gross morphology between different genera, and all are characterized by having a large number of secondary constrictions. The details of the chromosome morphology could be brought about with the application of new fixatives, with oxyquinoline as an ingredient.

As both male and female plants have been worked out and as no perceptible difference in chromosome morphology could be noted, sex determining process here has been supposed to be not controlled by a specialized sex chromosome mechanism.

On the basis of secondary association of bivalents four has been considered as the basic number of chromosomes in this family. A single line of evolution through amphidiploidy and structural changes of chromosomes has been visualized to be responsible for evolution within the family.

261. Cytogenetics of Some Members of Portulacaceae and Allied Families.

ARUN KUMAR SHARMA and NRIPENDRA K. BHATTACHARYYA, Calcutta.

A cytological investigation of the somatic chromosomes of eight different species of Portulacaceae and its allied family Aizoaceae has been worked out. The following are the names of the species investigated :—

Portulaca quadrifida Linn.

Portulaca cleraceae Linn.

Portulaca grandiflora (single variety) Hook

Portulaca grandiflora (double variety) Hook

Portulaca sp. (unidentified)

Sesuvium portulacastrum Linn.

Trianthema monogyna Linn.

Mollugo hirs Thumb.

Meiosis has been worked out in *Portulaca grandiflora*—single and double variety, *Portulaca* sp. (unidentified), *Sesuvium portulacastrum*, *Trianthema monogyna* and *Mollugo hirs*.

Detailed karyotype study has been done in three species, namely *Portulaca grandiflora*—single and double varieties, and *Portulaca* sp. (unidentified). Similarity in chromosome morphology as well as in phenotypic characters between these three species have been shown. Taking into account the data gathered on the cytology of all the species worked out during the present investigation as well as elsewhere, the genus is supposed to represent a homogenous line of evolution.

Role of polyploidy in speciation in the family has been emphasized in view of the data gathered so far as this aspect in these species. High Polyploid types such as *Portulaca oleracea* with forty-five chromosomes and *P. quadrifida* with thirty-six chromosome in the body cells have been recorded in the present investigation.

Three species of the family Aizoaceae, investigated here, namely, *Sesuvium portulacastrum*, *Mullugo hirta* and *Trianthema monogyna* show much similarity in the structure of chromosome with that of the different species of the genus *Portulaca*. The significance of this has been discussed.

Evidences have been gathered showing the wider tolerance range of polyploids in comparison to diploids so far as ecological conditions are concerned.

262. Effect of Chemicals on *Coriandrum Sativum*.

ARUN KUMAR SHARMA AND PRAFULLA C. DUTTA, Calcutta.

The paper deals with a report on an artificially induced tetraploid of *Coriandrum sativum* through Colchicine treatment by the authors. The tetraploids show considerable change in characters of the stomata, guard cells, epidermal cells as well as the stomatal frequency and index. The tetraploids are much stouter with darker green and fleshier leaves in comparison to diploids. There is a considerable change in size of the flowers, fruits and umbels. Seed-setting has been found to be very low. Chromosome numbers show the tetraploid (44 chromosomes) constitution and considerable irregularities in meiosis are recorded.

263. Induction of Division in the Adult Cells by Hormones.

ARUN KUMAR SHARMA and RAMENDRA NATH MUKHERJEE, Calcutta.

The present investigation deals with the possibilities of the use of a number of hormones in inducing division in non-meristematic nuclei. The four different hormones tried on roots of *Allium cepa* are phenylacetic acid, -naphthaleneacetic acid, -naphthoxy acetic acid and -indolyl propionic acid.

Phenyl acetic acid has been found to be most effective for the purpose. The polyploid non-meristematic cells, which are induced to divide, have been found to pass through all the stages of divisional cycle. The frequency of division gradually increases with increase in the period of treatment upto a certain limit. On reaching this optimum level, the frequency to certain extent decreases with further increase of treatment period. Sharp rise again is noted following growth for recovery in Knop's solution. The significance of such behaviour has been pointed out and the induction of division has been supposed to be caused possibly indirectly by an acceleration of nucleic acid synthesis. In addition to induction of division, somatic reduction too has been noted, which has also been attributed to a change in the nucleic acid balance of the cells. The other abnormalities have been accounted for, on the basis of disturbed metabolism.

Of the other three hormones, comparatively better effects have been noted in naphthalene acetic acid, but there too the induced division of the nucleus has not been found to proceed after prophase. This behaviour has been considered as

due to the inefficiency of the hormone concerned in meeting the absolute nucleic acid requirement of the polyploid cells to undergo complete division.

The data have been claimed as a support of the suggestion of the polyploid constitution of differentiated cells by Huskins. Phenylacetic acid has been recommended in the present report for induction of division in non-meristematic cells.

264. Effect of Chemical Mutagens on Floral Shoots of Onion.

ARUN KUMAR SHARMA and RAMENDRA NATH MUKHERJEE, Calcutta.

The results of a study of the effects of chemicals on meiosis of *Allium Cepa* have been reported in the present paper. A number of phenols, viz., Pyrogallol, Resorcinol and Hydroquinone have been tried in different concentrations. The chemicals have been applied by means of a hypodermic syringe at the base of the scape. Observations have been carried out after 24 and 48 hours of treatment, and the abnormalities in chromosome divisions were noted. Of all the chemicals tried, only the effect of Pyrogallol could not be studied due to blackening of the tissue following this treatment.

Of all the abnormalities noted most frequent was the chromosome stickiness resulting in the formation of groups, as well as lagging chromosomes, fragments as well as unequal separation during division. The stickiness has been accounted for on the basis of possible de-polymerisation of nucleic acids. The origin of fragments has been suggested as due to direct fragmentation of chromosomes by chemicals, or they may have originated due to the strain resulting in chromosome segments following unequal separation of chemicals.

265. Irradiation—Its Effect on Young Metabolic Nuclei and the Biochemical Changes Involved.

ARUN KUMAR SHARMA and Miss MIRA ROY, Calcutta.

Irradiation experiments were carried out with bulbs of onion applying dosages of 250r and 1000r and subsequently grown in 32°C, 37°C and 12 to 18°C. Observations at intervals of 24 hours were carried out on emerging new roots every day. The results could thus be interpreted in terms of irradiation on metabolic nuclei of different ages.

At 250r dosage, there is a distinct change from the normal differential pre-pitiation of nucleus and cytoplasm. This is followed by restoration of normal activity during recovery. In cold temperature, the recovery is rapid, due possibly to restitution of the broken ends, facilitated through stickiness at cold temperature. In 1000r the effect is very drastic.

Cells irradiated at different stages of metabolic or the so-called resting phase show the same frequency of fragments while grown in room temperature, implying that broken ends can remain un-united for long. Irradiation has been suggested as responsible for causing a change in the colloidal set-up of the nucleus. A temporary check in the Brownian movement results in non-union of the broken ends. In cold temperature, however, stickiness favours restitution.

The metabolic cells of *Allium cepa*, with the procedure followed in the present work, as the suggestion goes, would provide all future workers with a handy method of dealing with an assemblage of metabolic cells—all homogeneous as far as their response to irradiation is concerned. This would eliminate the inherent limitations of dealing with a heterogeneous mass of cells.

266. The Chemical Nature of the Nucleolus.

ARUN KUMAR SHARMA and ARCHANA SHARMA, Calcutta.

The chemical nature of the nucleolus has been investigated following acid extraction through trichloroacetic acid and perchloric acid, digestion of proteins through pepsin and trypsin, followed by staining through either pyronin-methyl green or Feulgen-light green or both. Alkaline and acid phosphatase activity of the nucleolar components have also been investigated. It has been shown that a substance, resistant to both acid and enzymes used, is present in the hyaline perinucleolar zone. Both types of proteins could be located in the nucleolus, non-basic, —rich in alkaline phosphatase—being present in higher amount than the basic one. A very complex phospho-lipide has been shown to form a significant percentage of nucleolar matter.

267. Coloration of Vanaspati by Chlorophyll.

V. SUBRAHMANYAN and M. SRINIVASAN, Mysore.

The use of chlorophyll in toothpastes and other preparations is well known. The inadequacy of chlorophyll for colouring Vanaspati is discussed.

268. Behaviour of Tyrosine and Cystine on Paper Chromatograms and Their Quantitative Estimation.

N. SUBRAMANIAN and M. V. LAKSHMINARAYAN RAO, Mysore.

Sparingly soluble amino acids like tyrosine and cystine when spotted in neutral solution on paper and developed with not too highly alkaline or acid solvents give long streaks which vitiate their separation from other amino acids. A sequential study of the movement and shape of the spots of these amino acids at various concentrations in a number of solvents has shown that the streaking is to be ascribed to the lag in the equilibration of the solute between the mobile solvent and the stationary phase owing to its poor solubility. Very high or very low spot pH, and the employment of highly acidic or alkaline solvents ensures rapid equilibration of the solute between the two phases and results in compact spots and satisfactory separations.

INDUSTRIAL CHEMISTRY**269. Briquetting of Weathered Coal fines. Part II.**

D. P. AGRAWAL, M. G. KRISHNA and S. HUSAIN ZAHEER, Hyderabad-Dn.

In this part the influence of pressure of briquetting and temperature and duration of mixing on two strength of briquettes of weathered coal fines using L.T. Tar (heavy fraction) obtained from Lurgi Spuelgas Plant have been reported. It is found that the strength of the briquettes increases with pressure. It is noted that water content of the coal, lime, and tar mixture plays an important part in briquetting and the lime-tar reaction. Best briquettes are obtained if the temperature of mixing is maintained at 70°C and continuous mixing is done for at least 15 minutes.

270. Kinetics of the Bulk Polymerisation of Vinyl Benzoate.

S. BANERJEE and M. S. MUTHANA, Kharagpur.

The kinetics of polymerisation of vinyl benzoate in bulk have been studied using benzoyl peroxide as the initiator. The over-all rate of polymerisation has

been found to be a linear function of the square root of the initiator concentration and the reaction is of the first order with respect to the monomer concentration. The intrinsic viscosity of the polymers has been found to increase with increasing degree of conversion while the Huggin's constant K decreases.

271. Studies in the Variation of Physical Properties of Humified Clays and Soil.

O. P. BANSAL, and A. K. BHATTACHARYA, Agra.

Rajmahal, Kashimbazar and Simultala clays and Agra soils were humified with different kinds of leaves and cow dung and their clay percentage, sticky point, porosity and wilting percentage were determined. It has been found that the raw organics increase the porosity, sticky point and wilting percentage but no correlation between clay percentage and the above physical properties was observed.

The relation between the clay percentage, total exchangeable bases and organic carbon of the humified and unhumified samples was worked out using the relation derived by Williams, but the constants derived by him have to be modified in order to get a fairly good agreement.

272. Study on Fischer-Tropsch Synthesis, Part VI, Synthesis with Coal-gas Using Cobalt and Iron Catalysts.

G. C. BASAK and N. C. NIYOGI, Howrah.

The work described in the paper, relates to the removal of Carbon Monoxide of Coal-gas by its reaction with hydrogen present in it, forming various Hydrocarbons. The removal of carbon monoxide does not only make the gas devoid of its poisonous character but by forming additional methane and other gaseous hydrocarbons it increases the resultant calorific value of the residual gas. A part of the carbon monoxide is also found to be hydrogenated to liquid products which may be used as fuel and lubricants.

To carry out the synthesis reaction, the coal-gas was first de-sulphurised by passing it through a bed of alkalis ferric oxide contained in a tubular electric furnace raised to a temperature of 250° . The resulting gas was then passed through a bed of cobalt catalyst (100 Co : 5 ThO_2 : 10 MgO : 80 Kieselguhr with a bulk density of 0.36 Kg per lit.) after reducing it in a stream of hydrogen at a space velocity of 3000 and at a temperature of 400°C for two hours. The gas was similarly passed through a bed of iron catalyst (100 Fe : 5 Cu : 10 CaO : 30 Kieselguhr with a bulk density of 0.77 Kg per lit.) after being reduced with hydrogen at 275°C and at a space velocity of 1000 for an hour.

From the results of analyses of inlet and exit gases at different temperatures, the efficiency of conversion to products expressed in percentages were shown. It was found that with the cobalt catalyst the synthesis reaction started at 180°C showing maximum contraction of 14% at 180°C . At 190°C CH_4 was found as the only product of reaction. The yield of liquifiable products per Cu.M of coal-gas was very low giving only an yield of 18 gms. per Cu.M. of gas. This low figure is presumably due to low percentage of carbon monoxide in the gas which decreased from 5.77% in the original gas to 0.6% in the exit gas showing nearly total removal of carbon monoxide thus making the gas harmless in character. The calorific value of coal gas used in the synthesis was 398 B.Th.U. per cu.ft. and showed an increase to 438 B.Th.U. per cu.ft. in the exit gas i.e. an increase of about 10%.

The results with iron catalyst were, however, not encouraging because of very low percentage of carbon monoxide in the coal gas. This is explained by the fact that iron-catalysts have been known to initiate synthesis reaction at a much higher

partial pressure of carbon monoxide; its proportion in synthesis gas is generally $3\text{CO} : 2\text{H}_2$ or $1\text{CO} : 1\text{H}_2$.

273. Cation Exchange Resins from Sucrose—Part I, Preparation and Operating Characteristics.

K. G. BHATLA and S. MUKHERJEE, Kanpur.

A number of cation exchange resins were prepared by the reaction of sucrose and phenol-sulfonic acid with different proportions, at different temperatures. The capacity data obtained using the limiting exchange value method shows that the resin CS 130-1 (i.e. resin prepared by condensation of sucrose : phenol-sulfonic acid in the ratio 1:1 at 130°C) exhibit the highest capacity 1.6 m.eq/gm. The exchange capacity of the resin CS 130-1 was further determined by different methods and the results were similar.

The column performance of the resin CS 130-1 was also studied in sodium hydrogen cycle. The resin CS 130-1 exchanged almost 100% of the Na^+ at a regeneration level of 1.60 m.eq/c.c. of the resin. Similar exchange was obtained at regeneration level 1.30 m.eq/c.c. and 1.0 m.eq/c.c. The plot of regeneration level against capacity shows an increase in capacity upto a regeneration level of 1.0 m.eq/c.c. of the resin CS 130-1 after which the increase was negligible.

274. Utilisation of *Momordica charantia* Seed Fats.

M. M. CHAKRABARTY and A. K. BISWAS, Calcutta.

Momordica charantia Linn. variety Muricata (Beng. and Hindi—Karela) seed fat the composition of which was previously reported by Chaudhury, Chakrabarty and Mukherji (Proc. 42nd Ind. Science Congress, 1955, Part III and Die Naturwissenschaften, Heft 11, p. 344, 42, 1955) contains on the average about 50% conjugated triene acid and 9% linoleic acid in addition to oleic (12%) and saturated (30%) acids. The oil content of the seed is nearly 35%. Experiments have been undertaken to find the suitability of the oil in the paint and varnish industry. The oil could be easily bodied to stand oil consistency, without much darkening. Varnish samples were prepared using Beckacite, Ester-gum and Bedesol-66 as the resin-component, 0.5% Pb and 0.05% Co as driers, a standard cooking procedure, and xylene-toluene (50:50) mixture in the first case and white spirit as diluents in the last two cases. The varnishes prepared were found to be quite good from the point of view of gloss, scratch resistance and colour. The drying time was longer in comparison with tung oil varnishes as would be expected from low triene content. It is suggested that longer cooking time and blending with other oils might improve this defect. Further studies are in progress.

275. Utilisation of Some Less-known Oilseeds.

M. M. CHAKRABARTY, S. R. CHAKRABARTY and N. K. SEN, Calcutta.

The utilisation of some less-known oilseeds namely tobacco seed, tea seed, jute seed and some seed fats obtained from the *Cucurbitaceae* family has been discussed with details of analytical data obtained by modern method of fat analysis. Recent statistical data for consumption and utilisation of fats in India have been given.

276. On Desulphurisation of Alloys in Hydrogen.

B. CHATTERJEE and K. R. SANGAMESWARAM, Sibpur.

Studies have been made on the progressive removal of sulphur from powdered samples of a specimen of cast iron (Mn, 1.25% and S, 1.25%) on heating at 1000°C

in a current of hydrogen containing 1.25 per cent. by volume of moisture. The sulphur content has been found to decrease to 0.58 per cent. in 8 hours and to 0.50% in 25 hours. The results confirm our previous observation, viz., that on treatment with moist hydrogen, the sulphur contents of alloys can be reduced to values below that correspond to the compound MnS . These results are of interest in that sulphur has a greater affinity for manganese compared to hydrogen.

277. Ion Exchangers from Lac.

A. N. DHAR, Patna.

Cation exchange resins have been prepared by sulfonating (1) a swollen mass of lac in different proportions of phenol and (2) a mixture of lac and resorcinol at temperatures between 130° - $145^{\circ}C$ followed by condensation and cross linking with resorcinol and formaldehyde in alkaline medium. Even old self-polymerised seed lac or shellac can be used to give resins suitable for the usual industrial purposes of removal of ions like Cu, Al, Ca, Mg, Co, Ni, Fe etc. from their salt solutions.

The results of the capacity determination of typical resins as obtained by different methods are shown below. Resin A contains 1/3 part phenol and seed lac 1 part while resin B contains equal parts of shellac and resorcinol.

TABLE I

Resin	In presence of NaCl at $30^{\circ}C$		From $BaSO_4$ determi- nation	From limiting exchange with $BaCl_2$
	pH 7	pH 11		
A	1.32	-3	1.28	1.28
B	1.52	-3	1.50	1.50

The resins are stable under all working conditions.

278. After-tack in Dehydrated Castor Oil.

K. K. DOLE and V. R. AMBEDKAR, Poona.

Dehydrated castor oil has a combination of properties useful in surface coating industry. However, it exhibits after-tack which is persistent for some time after the film has dried, and to which many causes have been ascribed, such as decomposition products, undehydrated castor oil, hydrolysed products, etc. It may also be due to geometrical isomers, cis and trans, which show difference in uptake of oxygen. Elimination of after-tack is suggested by condensation of D.C.O. fatty acids with higher polyhydric alcohols. It has been suggested that after-tack is associated with conjugation present in D.C.O. Dehydration of castor oil is accompanied by side reactions, such as polymerisation, isomerisation, hydrolysis, decomposition, and estolide formation. These reactions produce different types of D.C.O. and cause after-tack. The dehydrated castor oil is fractionated into three fractions using iso-propyl alcohol to separate the species, and studied for film properties and physical constants.

It is found that first and second fraction films do not show any after-tack. The after-tack, however, is maximum in films from the third fraction, which consists of undehydrated castor oil, partially hydrolysed oil, free fatty acids, decomposition

products, etc. The first fraction is mainly polymerised D.C.O. Second fraction is monomeric D.C.O. or semi-polymerised oil. These fractions give tack-free films.

279. Preparing Dehydrated Castor Oil with Benzene Trisulphonic Acid as the Catalyst.

K. K. DOLE and V. A. SARAF, Poona.

Benzene trisulphonic acid is a very active catalyst for the dehydration of castor oil. The quantity of the catalyst required for dehydration is much less than that required with the usual catalysts, viz., monosulphonic acids, salts of phenol-substituted sulphonic acids, sodium bisulphate, etc.

Benzene trisulphonic acid is equally active under reduced pressure, and the percentage of the catalyst required for dehydration is comparatively less. The dehydrated sample obtained under reduced pressure is pale in colour and low in acid number.

The dehydrated castor oil obtained with this catalyst was successfully subjected to solvent fractionation. It gave three fractions. The first and second fractions give tackless films.

280. Laboratory Experiments on Electrolytic Method of Cane-juice Clarification.

K. S. G. DOSS, S. L. GUPTA, N. RAJGOPALAN, K. H. RAO and VISHNU,
Kanpur.

A number of laboratory experiments were tried on Ghosh's process of cane juice clarification. The juice was analysed for pol-purity rise, sucrose purity rise, iron, ash and reducing matters present. Spectrophotometric determination of colour at different wave lengths was carried out using clear juices obtained by different techniques. In order to reduce the consumption of electricity and iron during electrolysis the process was modified. The modified process showed a considerable saving in electricity and iron consumption during electrolysis. The iron content of final juice is also found to be lower which would result in the production of better sugar. The general economics of the process has also been discussed.

281. Selective Flotation of Minerals with Fatty Acid Collectors.

C. N. GOVINDA RAO, M. S. MOHAN and C. C. PATEL, Bangalore.

Caproic acid has been employed as a collector in the selective flotation of chalcopyrites from silicious and pyritic copper ore of Ingaldhal, Mysore State and pyrolusite from ferruginous manganese ore of Goa. At a pH range of 6-6.5, it is found that chalcopyrites could be successfully floated from pyrites. The differential flotation of pyrolusite and haematite from Goa employing caproic acid as the collector, has not proved very satisfactory in the separation of constituent minerals.

282. Studies on the Velocity of Flow of Organic Liquids through Chromatographic Columns in Relation to Viscosity, Height of the Column and Density.

D. R. GUPTA and ABANI K. BHATTACHARYA, Agra.

The velocity of flow of a pure liquid is interestingly connected with the height of the column, density and viscosity of the liquid. It has been observed that in the homologous family of carbon compounds, the expression $\frac{vh}{t} \frac{\eta}{d}$ is a constant, where v is the volume in c.c. flowing through the column in time t , h the height of the column, η the viscosity and d the density of the liquid. The constants for

different families of homologous series are different for the same adsorbent column. This appears to be due to the structural characteristics and hence the functional groups of the compounds. For different adsorbents the constants for the same homologues were also different suggesting that the velocity of flow of such liquids not only depended upon the structure of the liquid molecules but also on the characteristics of the surface active substance. These observations give evidence in favour of molecular orientation on the surface of the active adsorbent, when a liquid is made to flow through the capillaries of the chromatographic column under the same conditions of temperature and pressure.

It was further observed that the values of vh/t (volume of liquid flowing in unit time through unit height) became constant for an optimum height (4.5-5 cms.) under our experimental conditions. Heights less than this optimum gave slightly lower values of vh/t . This little difference in vh/t seems to be due to a little greater compactness in the lower region which becomes less effective as the height approaches 4.5-5 cms. under the experimental conditions maintained.

The role of grading the size of the adsorbent particles has also been observed. The rate of flow (vh/t) slightly increases with the decrease in the size grade and this has been shown by packing the columns with particles which were sieved and graded between 60-80 mesh, 80-100 mesh and 100-120 mesh. The reason for the increase in the velocity of flow for smaller particles has been explained by the greater cohesive force between these particles with consequent diminution in the area of the annular liquid film between them. The pressure on the film is thereby slightly increased and hence the flow increases.

The value of $\frac{vh}{t} \frac{\eta}{d}$ for each homologous series remains constant for the same grading of particles, as had been observed in a wider range of grading previously.

283. Corrosion of Iron in Water and Action of Dissolved Substances.

B. P. GYANI and Miss RANI MISRA, Patna.

Corrosive action of a number of solutions on pure iron wire have been studied over a period of two years. Sodium carbonate, when at least N/50 and sodium nitrite and ammonia at even lower concentration (N/1000) appear to inhibit corrosion permanently. N/100 solutions of sodium acetate, propionate, succinate, benzoate and salicylate produced only temporary inhibitions extending to six or seven months. The limitation may be due to destruction of the organic materials. Changes in the potential of an iron wire dipped in water and N/100 NaNO_2 solutions have been followed with time. In water the potential is negative all the time and increases in numerical value with time, at first rapidly, then slowly. It is positive (with respect to normal hydrogen electrode) and practically constant in sodium nitrite (about 0.05 volt) provided the entire electrode dips in the solution. Theoretically, therefore there is no tendency for the iron to corrode in the latter solutions.

284. Studies on Hyderabad Fuller's Earths.

M. A. HAI, S. S. JOSHI and S. A. SALETORRE, Hyderabad-Deccan.

A few typical physical properties such as particle-size, bulk density and Hydrogen-ion concentration of various activated Fuller's Earths found in Hyderabad State, were determined. Their influence on colour adsorption capacity in the case of groundnut oil was investigated and compared with similar data obtained with samples of bleaching earths actually used in industry. From these investigations,

it appears that particle-size along with bulk density have a bearing on the colour adsorption capacity of the earth sample.

285. Fullers Earths of Hyderabad State.

S. S. JOSHI and S. A. SALETORE, Hyderabad-Dn.

Recent detailed surveys for Fullers Earth in Hyderabad State have indicated the existence of this material in different parts of Chincholi taluk in Gulberga district. They are spread over a large area and found to occur in pockets and large beds, the total quantity available being estimated at well over 1.5 lakh tons. Two adjoining deposits near village Korvi account for nearly 1.0 lakh tons of same.

Representative samples from these various deposits have been examined and found to be of a very much better quality as regards impurities like grit, sand and acid solubles than the samples previously obtained from other localities. The samples have been activated by means of Hydrochloric acid and Sulphuric acid followed by heat activation at 350°C. The activity of these treated samples has been tested for colour adsorption in the case of groundnut oil. It has been found that 60-75% sulphuric acid gives as good results as 5 N hydrochloric acid for acid activation.

The activated earths thus produced compare favourably with market samples of bleaching earths.

286. Alkyd Resins Modified by Fatty Acids from D.C.O.

V. R. KESKAR and K. K. DOLE, Poona.

Fatty acids from dehydrated castor oil are employed as one of the ingredients for the preparation of alkyd resins. D.C.O. (dehydrated castor oil) samples were prepared under different conditions and with ten different catalysts. The alkyds were prepared with a view to study the effect of side reactions occurring during dehydration on the film properties of the alkyds. The rate of condensation of alkyd resin and the final colour differed with different fatty acid samples. The alkyd films set to touch quickly but attained hard dry condition very slowly. Air-dried films possessed some amount of aftertack. The films after baking at 120°C. for 90 minutes were quite excellent, hard and elastic and without any aftertack. The films were not affected by organic solvents and had excellent water resistance.

287. Cation Exchanges from South Arcot Lignite.

A. P. MADHAVAN NAIR and S. SUBRAHMANYAN, Madras.

Cation exchangers of good base exchange capacity have been prepared by sulphonation of South Arcot Lignite. The optimum conditions of sulphonation have been worked out after a thorough investigation of the influence of the variables such as the nature of the sulphonating agent, the ratio of acid : lignite, temperature and duration of sulphonation and the influence of catalysts. The sulphonating agents employed were 98 per cent sulphuric acid, oleums of 2, 5, 10 and 15 per cent strength, and gaseous sulphur trioxide. Sulphonating temperatures were varied between 30° and 150°C. The influence of catalysts like MnO_2 , V_2O_5 , CoO , HgO and Cr_2O_3 was also studied. In each case the purified product was well agitated with N. Barium chloride solution, the liberated acid estimated and thus the equilibrium exchange capacity determined. It has been found that the exchange capacity increases with acid : lignite ratio upto about 3 c.c. per gram beyond which the effect is small, that the reaction reaches completion in about 2 hours, although the quality of the product

improves by "ageing" for (gaseous SO_3 , the optimum time required was 5 hours), that Oleum gives a better product than H_2SO_4 , the quality being roughly proportional to the SO_3 content, and that gaseous SO_3 gave the best product. The optimum temperature was found to be in the region $90^\circ\text{--}100^\circ\text{C}$. The catalysts employed had no effect in improving the quality of the product. The maximum capacity obtainable was 1.95 milliequivalents/gram as compared with 1.5 to 1.6 of commercial products.

288. Graphite for Pencil Industry.

K. K. MAJUMDAR, Dhanbad.

Amorphous graphite constitutes one of the most important raw materials for the pencil industry, but unfortunately, indigenous graphite of suitable quality is not available. The characteristics of imported graphite for pencil industry have been investigated and the results are shown below : Graphite 'Superior', ash 4.49% ; particle size, max. 88 micron, min. 1, average 10 ; Graphite 'Superfine', ash 4.63% ; particle size max. 96, min. 2, average 7 ; Graphite 'Foliac', ash 3.83% ; particle size max. 44, min. 2, average 10 ; Graphite 'Mexico', ash 18.30% ; particle size max. 124, min. 1, average 15.

289. Ion Exchange Method of Cane Juice Clarification. The Effect of Ion Exchangers on Cane Juices Clarified by Different Techniques.

G. P. MATHUR and S. MUKHERJEE, Kanpur.

Sugarcane juices clarified by different processes, e.g. carbonation, sulphitation, Saha's New Technique and modified Ghosh's process were deionised by a single pass through a bed of cation exchanger Duolite C-3 H and Duolite A7 at temperatures between $20^\circ\text{C--}28^\circ\text{C}$ at a different service flow rate. The results have been tabulated and discussed. It was shown that by a single pass direct demineralisation it is possible to remove 90–96% of conductivity ash and most of the nitrogenous bodies without any appreciable inversion at operating temperatures between $20\text{--}28^\circ\text{C}$ and service flow rate varying from 0.09–0.452 litres/dm². The colour removal was very good and in almost all cases water white or very light yellow coloured juices were obtained, irrespective of the process of clarification of juice. In some cases the organic non-sugars removal was about 100%.

It was shown that there is no marked difference in demineralising cane juice clarified by New Technique, Standard Sulphitation or Double Carbonation. It was observed however that juices from Bombay-Deccan factories have got much lower ash content than juices from North Indian Sugar factories and therefore the former are much more suited to ion exchange treatment. The rise of purity of Bombay Deccan juices on Ion-exchange treatment are of the order of 7.5 units and according to Noel Derr S.J.M. formula about 6.6 per cent of additional sucrose is recoverable while with North India juices rise in purity is of the order of 10 units and therefore about 9.5% additional sucrose is recoverable.

290. Preliminary Studies on Plant Gums as Flocculating Agent for Cane Juice Clarification.

G. P. MATHUR and S. MUKHERJEE, Kanpur.

Studies on the structure of plant gums and mucilage show that these can be looked upon as naturally occurring high polymer having repeating units of glucuronic or galacturonic acid, which dissociates in water solution to give negatively charged particles with large number of active centres.

Preliminary experiments with jeel (*Odina Wodier*) gum, which contains galactogalacturonic acid have shown that it accelerates the rate of settling of calciumphosphate precipitate and its efficiency in settling is comparable to that of Lytron-X886 (a synthetic polyelectrolyte of Monsanto Chemicals Co. Ltd., U.S.A.).

Having shown that gums accelerate the settling of flocculous precipitates, their efficiency as flocculating agents for cane juice clarification was now studied. It has already been established by earlier workers that polyelectrolytes work well, in near about neutral pH, so that only optimum gum concentration which gives best results was determined. It was found that jeolic acid in 2 parts per million gave fastest settling rate, brighter and clean juice and compact mud.

291. Aluminium Tri-soaps.

R. C. MEHROTRA and K. C. PANDE, Lucknow.

The aluminium salts of higher fatty acids are important articles of commerce, but their nature and composition are surprisingly obscure. Over a period of twenty-five years, a number of workers have repeatedly reported their failure to prepare the tri-soaps of aluminium, and have concluded that the tri-soaps probably do not exist. It has been found that when one molecule of aluminium isopropoxide is treated with an excess of fatty acid in benzene, three molecules of isopropanol can be distilled out azeotropically. The products on removal of the fatty acids by suitable solvents such as dioxane or acetone, were in all cases found to be aluminium tri-soaps. Tri-valerate, tri-laurate, tri-myristate, tri-palmitate and tri-stearate of aluminium have been prepared by this method. The failure of earlier workers to prepare tri-soaps of aluminium has been explained on the basis of the slowness of the final stage of the reaction caused by steric hindrance. The hydroxy di-soaps of aluminium are well known to give gels in hydrocarbon solvents. McRoberts and Schulman predicted that tri-soaps, if prepared, would not show any tendency for gelation. In conformity with their views, the above tri-soaps of aluminium have been found to give quite mobile solutions in benzene.

292. Reaction of Tricalcium Phosphate and Ammonium Sulphate.

(Miss) AKHTAR MOHAJIR and D. S. DATAR, Hyderabad-Dn.

The experiments show the possibility of increasing the available phosphate content of the product by reaction of tricalcium phosphate, ammonium sulphate and sulphuric acid with an overall economy of sulphuric acid. The formation of ammonium citrate, soluble $\text{Ca}(\text{NH}_4)_4(\text{PO}_4)_2$ is indicated in this reaction.

293. Hydrogen Sulphide from Iron Pyrites.

K. N. MOORTHY and D. S. DATAR, Hyderabad-Dn.

The production of hydrogen sulphide by the reaction of iron pyrites, coke and steam is described in this paper. The reaction takes place with the formation of hydrogen sulphide and ferrous sulphide. The latter is then hydrolysed to ferrous hydroxide and hydrogen sulphide. In presence of sufficient coke the conversion of pyritic sulphur to hydrogen sulphide at 800°C is complete.

294. Studies on the System : Iron Pyrites + Sodium Carbonate + Air.

K. N. MOORTHY and D. S. DATAR, Hyderabad-Dn.

The system iron pyrites+sodium carbonate+air is studied. A suitable method for the preparation of sodium sulphate is suggested consisting of mixing thoroughly

sodium carbonate and iron pyrites in theoretical proportions and passing air over the mixture heated at 400°C. Air is completely utilised in the reaction and 80-85 per cent of pyritic sulphur is oxidised to sodium sulphate. The remaining pyritic sulphur is oxidised to sodium sulphite which can be further converted to sodium sulphate by a suitable method. The sulphate obtained is free of iron.

295. Studies on the Oxidation of Iron Pyrites.

K. N. MOORTHY and D. S. DATAR, Hyderabad-Dn.

A mechanism has been given for the oxidation of iron pyrites based on the following assumptions : (i) Half of the sulphur in the pyrites is oxidised to sulphur dioxide (ii) The remaining half is oxidised to ferrous sulphate (iii) Ferrous sulphate is decomposed liberating sulphur dioxide either directly or through the formation of ferric sulphate and (iv) Sulphur trioxide thus produced is decomposed slowly to sulphur dioxide. The suggested mechanism explains the observations made regarding the products of oxidation and other data obtained in the study.

296. Further Study on Magnesium Sulphate from Iron Pyrites.

K. N. MOORTHY and D. S. DATAR, Hyderabad-Dn.

The reaction of iron pyrites and magnesium oxide was studied by passing air over the reaction mixture at 400°C. The percentage conversion of pyritic sulphur to magnesium sulphate is 50%. The yield of magnesium sulphate is increased to 60%, by increasing the proportion of magnesium-oxide to 3 times the theoretical quantity.

The most suitable method for making magnesium sulphate appears to be to pass air over mixture of iron pyrites and magnesium oxide containing $\text{FeS}_2 : \text{MgO} : 1 : 1$ molar proportion at 400°C. adjusting the rate of supply of air. Under these conditions, magnesium oxide will completely react giving magnesium sulphate. Sulphur dioxide and some sulphur trioxide which are evolved simultaneously can be absorbed in suspension of magnesium oxide in water when magnesium sulphite and magnesium sulphate are produced. The former can be further oxidised to magnesium sulphate by air. It is seen that the latter reaction is comparatively slow.

297. Drying Properties of Argemone Oil.

MADAN MURARI and B. P. GYANI, Patna.

Raw argemone oil takes about 24 hours at 32-33° to give a product which is tack dry. This time is reduced to about 20 hours when linoleates or naphthanates of lead, cobalt and manganese are mixed, the period remaining the same if dehydrated argemone oil instead of the raw oil is taken. If, however, the alkaloids sanguinarine and dihydrosanguinarine are removed from the natural oil, the period is reduced to 17 hours and a satisfactorily dry product is obtained.

298. Preparation of Ordinary D.C.O. Alkyd by the Monoglyceride Method with Lead Oxide Catalyst using Xylene as Azeotropic Solvent.

N. BHOJRAJ NAIDU and S. A. SALETORE, Hyderabad-Dn.

The object of the present investigation was not only to mask the after tack associated with D.C.O. by copolymerisation of same with alkyds but also to study the conditions of temperature etc. for controlling the risk of gelation, and finally obtain

a product compatible with xylene, butyl alcohol and butyl acetate. The glycerol D.C.O. resin of 40 per cent oil length of 3.32 poises viscosity at 30°C. had an acid value of 31.7, and gave a film which dried in about 1½ hours (lint-free). A comparison of same was also made with pentaerythritol D.C.O. resin. The glycerol D.C.O. resin gave wrinkle finishes; a property which is likely to be due to the conjugated nature of the oil used for copolymerisation.

299. Preparation of Monomeric D.C.O. Alkyd by the Monoglyceride Method with Lead Oxide and Calcium hydroxide as Catalysts using Xylene as Azeotropic Solvent.

N. BHOJRAJ NAIDU and S. A. SALETORÉ, Hyderabad-Dn.

This paper gives the preparation of alkyds of 40, 50, and 66 percent oil length, using glycerol and pentaerythritol. The resins thus prepared have been compared and paints made from same. The alkyd copolymerised with monomeric D.C.O. of long oil length 66 per cent is tack-free, thereby showing that the low viscosity monomeric oil has decided advantages over the ordinary D.C.O. of a higher viscosity. The pentaerythritol resin of 66 per cent oil length having a viscosity of 1.0 poises at 27°C. had an acid value of 7.7 and gave films which dried in 2¼ hours, set to touch time.

300. Effect of Ageing of the Hull on the Yields and Activity of Active Carbon Prepared from Groundnut Hull.

T. L. NARASIMHA RAO and D. S. DATAR, Hyderabad-Dn.

The effect of ageing of the groundnut hull on the yields and activity of active carbon was studied. Experiments were conducted using the hulls from freshly produced groundnut and from groundnut stored for a year. It was seen that samples with improved adsorption properties were obtained from fresh hulls and the optimum proportion of zinc chloride was 50% on the weight of the hull, the temperature of carbonisation being 400°C.

301. Studies on the Utilisation of Active Carbon from Groundnut Hull for the Refining of Vegetable Oils.

T. L. NARASIMHA RAO and D. S. DATAR, Hyderabad-Deccan.

Studies on the bleaching of groundnut oil and alkali refined cotton seed oil were made using groundnut hull carbon in admixture with two types of fuller's earth. It is seen that the bleaching obtained by using groundnut hull carbon along with fuller's earth is comparable with imported oil carbon samples, when conditions of experiment are temperature 95°C and duration of bleach ¾ hour.

302. Studies on the utilisation of active carbons prepared from groundnut hull in the refining of jaggery.

T. L. NARASIMHA RAO and D. S. DATAR, Hyderabad-Dn.

The suitability of active carbons prepared from groundnut hull using zinc chloride and ferric chloride as activating agents for the decolorisation of jaggery is studied. It is seen that the samples obtained with ferric chloride as activating agent are better than the corresponding samples prepared using zinc chloride as activating agent.

303. Studies on Potassium Permanganate Adsorption by Active Carbon from "Coalsite".

T. L. NARASIMHA RAO and D. S. DATAR, Hyderabad-Dn.

Studies on potassium permanganate adsorption were made using 'coalsite' (a low temperature coke obtained from Singareni coal) and active carbon prepared from coalsite by the process of air activation. It is seen that the adsorption of potassium permanganate by the activated coalsite is about ten times of that shown by coalside. The adsorbed permanganate is reduced to manganese dioxide in both the cases.

304. Studies on Shrinkage Phenomenon—Part I. Tanning with Aliphatic Sulphonyl Chlorides.

Y. NAYUDAMMA and T. S. RANGANATHAN, Madras.

Very little information is available with regard to the theory of tannage with aliphatic sulphonyl chlorides. The shrinkage temperature measurement has been used as a tool to gain knowledge on the mechanism of tanning, using sulphonyl chlorides as pretanning and retanning agent in combination with other known tanning agents as chrome, vegetable, formaldehyde, oil and syntans.

305. Studies on Shrinkage Phenomenon—Part II. Tanning with Formaldehyde.

Y. NAYUDAMMA and T. S. KRISHNAN, Madras.

Extensive work has been done with regard to protein-formaldehyde reaction and its reactivity with protein in combination with other tanning agents has not been studied to any great detail. The shrinkage temperature data for the collagen tanned with formaldehyde in combination with other known tanning agents and syntans were obtained and the theoretical aspects of the mechanism of the formaldehyde tanning in combination with other tanning agents are discussed.

306. Production of Hydrogensulphide from Gypsum.

(Miss) RAZIA OSMANI and D. S. DATAR, Hyderabad-Dn.

A new method has been evolved for the production of hydrogen sulphide from Gypsum. It consists of passing steam over a heated mixture of gypsum and coal or coke at 800°C. The sulphur in the sulphate can be completely recovered as hydrogen sulphide by this method.

307. Sulphur Dioxide from Calcium Sulphate—Part I. Thermal Decomposition of Calcium Sulphate and Sodium Sulphate Mixture.

(Miss) RAZIA OSMANI and D. S. DATAR, Hyderabad-Dn.

It was earlier reported that the thermal decomposition of calcium sulphate is accelerated by the addition of alumina. It is now seen that addition of sodium sulphate further accelerates the decomposition. Presumably aluminium sulphate is formed at an intermediate stage and is decomposed to alumina, sulphur dioxide and oxygen. Calcium and sodium aluminates are produced later, which yield sodium hydroxide, calcium hydroxide and alumina by suitable reactions.

A new method based on these reactions has been described in this paper for the production of sulphur dioxide from gypsum. Sodium hydroxide and pure alumina are obtained as byproducts.

308. Sulphur Dioxide from Calcium Sulphate—Part II. Thermal Decomposition of Calcium Sulphate and Sodium Carbonate (or Sodium Hydroxide) Mixture.

(Miss) RAZIA OSMANI and D. S. DATAR, Hyderabad-Dn.

The decomposition of calcium sulphate is accelerated by the addition of sodium carbonate or sodium hydroxide. It is 80 per cent with sodium hydroxide and 65 per cent with sodium carbonate. In both the cases, it is less than that in case of sodium sulphate and calcium sulphate mixture.

309. Sulphur Dioxide from Calcium Sulphate—Part III. Thermal Decomposition of Calcium Sulphate and Magnesium Sulphate Mixture.

(Miss) RAZIA OSMANI and D. S. DATAR, Hyderabad-Dn.

The decomposition of Calcium sulphate in presence of alumina is considerably induced by the presence of magnesium sulphate, which is also simultaneously decomposed.

310. Rot-Proofing of Jute by Treating with Soluble Copper Salt.

P. N. PAL, Calcutta.

A considerable degree of rot-resistance is imparted to jute materials by dipping them into a bath of a soluble copper salt, such as cupric sulphate or acetate; under such circumstances copper is taken up by jute in appreciable amounts and is fairly resistant to the leaching action of water. It is believed that copper is bound by chemical combination with suitable reactive groups present mainly in the non-cellulosic constituents of jute. In view of the relative cheapness and ease of operation, this method of rot-proofing of jute appears to have considerable practical possibilities.

311. The Influence of pH in Pyrophosphate Solutions for Nickel Plating.

S. K. PANIKKAR and T. L. RAMACHAR, Bangalore.

pH plays an important part in alkaline pyrophosphate solutions for nickel plating. The buffering capacity of various substances has been studied and ammonium citrate has been found to be the best buffering agent for plating.

312. A study of Antioxidants for Mahua Oil.

OM PRAKASH, ATMA RAM and S. C. PANDEY, Kanpur.

Mahua oil which is a good soap making oil in all other respects suffers from the drawback that soaps made from it tend to get rancid during storage. For this reason it can not be used in good quality toilet soaps. Therefore with a view to improve the oil in this respect effect of various antioxidants such as gallic acid, hydroquinon, pyrogallol, tannic acid and citric acid on the oil has been studied. A modified form of the apparatus employed by King and coworkers has been used and the progress of rancidity has been studied by observing the change produced in Butyro Refractometer reading, Acid Value, Peroxide Value and Kreis test. Hydroquinon has been found to be the best antioxidant.

313. Keeping quality of Mustard Oil on Storage in different types of containers.

OM PRAKASH, T. R. SHARMA and V. D. ATHAWALE, Kanpur.

Mustard oil from expeller, power driven rotary ghani and improved Wardha ghani (bullock driven) was separately stored in three types of metal containers commonly used for storage of oils viz. tinned iron, galvanized iron and black sheet. Each oil was stored under two different conditions i.e. open to atmosphere and closed. Various physical and chemical characteristics of the oils were determined at regular intervals of two months upto a period of two years. Organoleptic tests showed no appreciable deterioration of oil in closed containers upto a period of 18 months in G. I. and black sheet containers whereas in tinned containers deterioration was not observed even upto 24 months. In the oils in open containers rancidity appeared after about 8 months and in about 14 to 18 months the oils were completely rancid in almost all cases. Viscosity of oils increased slightly in closed containers whereas in open containers it considerably increased. Peroxide value increased upto 14 months after which it declined in closed containers whereas in open containers it constantly increased upto the end of two years. Metal dissolved in oil was maximum in black sheet containers and minimum in tinned containers. Allyl isothiocyanate content was very little affected in almost all closed containers but in open containers it had almost disappeared.

314. Market Data for the Fine Chemical Industry in India.

A. RAHMAN, Hyderabad-Deccan.

An analysis of the type of data required in developmental problems is summarised. A rapid survey is made of the sources of information in the country—through Central Services, through individual organisations and factories and through journals. Much general information is readily available, but detailed data on chemical processes in India and their relative efficiency is rarely published and very difficult to obtain, making the collection of such data laborious and generally unsatisfactory.

From our many attempts at Central Laboratories for Scientific and Industrial Research, Hyderabad, three case-examples are described; general conclusions are drawn with suggestions for improvements.

315. Systematic Investigation of Soil Organic Matter. Part IV. Identification of Amino-acids in the Hematomelanic Acid Fraction.

NEWTON RAM and ABANI K. BHATTACHARYA, Agra.

Several fractions were obtained by different treatments of the humic acid of the hydrolysate of Ara soil. The fraction conventionally called the "hematomelanic acid" was soxhletised with benzene for six hours and the insoluble part was further hydrolysed with $N/2HCl$ for the same period. The insoluble part contained nitrogen only, while the fraction soluble in HCl contained nitrogen and sulphur. The technique of paper partition was employed to identify the amino-acids present in the latter fraction. The following amino-acids were identified :—Aspartic acid, Arginine, Histidine, Valine, Isoleucine, Leucine and Methionine both by ascending and descending methods of paper chromatography.

It appears that there is a great similarity between the proteins of the soil in the temperate and the tropical zones and this will be further elucidated by examining other fraction of the Agra soil hydrolysates in course of time.

316. Solvent Extraction of Vegetable Oils—Part II. Comparison of the Solubility results obtained by Solubility Determination Apparatus with those obtained by different methods.

K. RAMALINGAM and K. S. CHARI, Hyderabad-Dn.

The solubility data of Cottonseed oil in 95% ethanol, obtained by various workers have been compared with the results determined by Solubility Determination Apparatus. The lower values of the different authors have been explained in detail. Experiments were carried out to get solubility data of refined cottonseed oil in 95% ethanol, employing seal-tube method, flask method and solubility determination apparatus method. The lower solubility results obtained by the seal-tube method and flask method have been discussed fully. The salient features of the Solubility Determination Apparatus and the method employed are clearly enunciated.

317. Chlorination of Mineral Oils and their use in Leather Industry.

D. RAMASWAMY, Y. NAYUDAMMA and B. M. DAS, Madras.

Oils and fats of vegetable, marine and mineral origin have been used in the tanning industry from good old days. Chlorinated mineral oils were first developed in Germany during the world war to meet the deficiency from natural supply. Since both the raw materials are cheap and readily available in India and the utilisation of by-product chlorine is of great importance to the caustic soda industry, the problem of manufacture of leather oils should be of great commercial interest. Various raw materials were chlorinated to the desired extent and their possible use in the leather industry examined. The suitable raw materials and optimum conditions of chlorination for use in leather industry are described.

318. Direct preparation of Soap from Cotton Seed.

N. K. ROY CHAUDHURI and S. K. NANDI, Kharagpur.

Cotton seed was dehulled in a Hammer Mill and the kernel boiled for a period of 3, 6 and 8 hours with caustic soda solution, the quantity of NaOH used being 10, 20 and 30 percent in excess of the theoretical amount required for saponification. The residue was separated from the soap solution by centrifuging and thoroughly washed with water. The solution, which was very dark coloured, was bleached by bleaching powder, the amount required for complete bleaching being about 30 percent of the weight of kernel. The soap solution was then completely evaporated to dryness with or without the addition of salt. The washing properties of the soap were quite good and good lather was obtained, but its main drawback was poor keeping quality and the soap became rancid in a few days. Further experiments are in progress to remove this drawback.

From the analysis of the oil content of the residue, it was found that by boiling with 10, 20 and 30 percent excess alkali for 3 hours, 17.7, 45 and 51.3 percent oil reacted with NaOH and by boiling with 10 percent excess alkali for 6 and 8 hours, 56 and 70 percent oil were converted into soap.

319. Multiple Stage Solvent Extraction of Cotton Seed Oil.

N. K. ROY CHAUDHURI and S. K. NANDI, Kharagpur.

Cotton Seed was delinted and dehulled in a hammer mill and the kernel extracted with two solvents, benzene and ethyl alcohol. Three extractions, each for a

period of 1 hour and with a seed solvent ratio of 1:2, were done at 25°C in a vessel fitted with mechanical agitator. After each extraction, the miscella was separated by centrifuging and the meal re-extracted with the requisite amount of solvent.

Average oil content of the kernel on moisture free basis was 26.5% and the moisture content was 10%. During the first, second and third extractions with Benzene 59%, 82.2% and 96.4% oil was extracted, leaving a residual oil content of 12.2, 5.7 and 1.2% respectively in the meal; the corresponding figures with alcohol being 47.1, 72.3 and 90.3%, with residual oil content of 15.2, 8.4 and 3.2%. When extraction was carried out with dry kernel with a moisture content of 0.1%, the extraction very much improved, giving an yield of 98% and 94% oil with benzene and alcohol respectively and the residual oil in meal was reduced to 0.7 and 1.9%.

320. Simultaneous Grinding and Extraction of Cotton Seed.

N. K. ROY CHAUDHURI and S. K. NANDI, Kharagpur.

Simultaneous grinding and extraction of cotton seed was done in 2 types of equipment :—(1) steel ball mill—8" dia. × 8" height, filled with fifty 1" steel balls and operated at 42 r.p.m. and (2) horizontal, disc. type attrition mill, operated at 1450 r.p.m., the grinding element of which consisted of a rotating disc, 4½" diameter, with concentric circular rows of ten ¾" high projecting spikes and meshing with those on the stationery plate. Extraction of cotton seed kernels was carried out at 25°C with two solvents, benzene and absolute alcohol, with a seed solvent ratio of 1:4. Similar extraction was carried out in an agitated vessel for comparison of the results.

15 minutes extraction with benzene in the agitated vessel, ball mill and attrition mill gave oil yields of 60, 62.4 and 81.1% respectively with residual oil content of 13.3, 11.3 and 6.8% in the meal; corresponding figures of oil extraction with alcohol being 55.2, 54.8 and 81%. By extraction for one hour in the agitated vessel and attrition mill, oil extracted was 65.4 and 84.7% respectively for benzene and 56.2 and 81.8% for alcohol. Results show that an attrition mill is extremely efficient for oil extraction.

321. Solvent Segregation of Mohua Oil.

A. N. SAHA, Calcutta.

Mohua oil has been extracted with two solvents namely ethyl alcohol and a mixture of 5% n-Butyl alcohol and 95% ethyl alcohol. The unsaturated glycerides could not be segregated successfully with the variation of solvent to oil ratio. But unsaponifiables can be concentrated in the extract phase. Among the solvents the mixture of n-butyl alcohol and ethyl alcohol was found to be better in performance.

322. Studies on Assam "Blue Oil" Fraction. Part I.

A. N. SAHA, Calcutta.

Assam blue oil top was found to have the following characteristics.

Density at 20°C	...	...	0.861	
Refractive Index at 20°C	...	...	1.4870	
Specific refraction	...	...	0.3353	
Viscosity at 68°F	...	...	43.0	Centistokes
Viscosity at 100°F	...	...	26	"
Viscosity at 210°F	...	...	12.7	"
Viscosity Index	...	...	192	
Viscosity gravity constant	...	...	0.824	
Aniline point	...	...	80°C	
Carbon residue	...	...	0.6%	
Bromine number	...	...	0.0	

after oxidation according to I.P.T. Method Viscosity and carbon residue were changed

Viscosity at 68°F ...	...	...	55.4 Centistokes
Carbon residue ...	...	...	4.6%

Waterman analysis showed the composition of the oil to be

Paraffin ...	...	...	82.7%
Naphthene ...	...	...	0.0%
Aromatics ...	...	...	17.3%

The oil can be converted into high quality lubricant by Phenol extraction. The equilibrium diagram has been found out.

323. Studies in wrinkle finish—Part II. Effect of resins, thinners on wrinkling.

A. N. SAHA and M. M. UPADHYAYA, Calcutta.

The wrinkles in the films produced by varying amount of Alkyd. modified phenolics, and copal, vary in their shape and size. Modified phenolic resins produce discontinuous lines with marked parallelism. The wrinkles obtained in case of alkyd are fine in texture. No regular pattern can be ascribed to it. Copal gives short fine bend lines without any regularity. The effect of their mixtures has been studied. Thinners namely toluene, turpentine, mineral turpentine have got considerable effect on the nature of wrinkles. The effect of cooking time and temperature has also been studied.

324. Studies on Storage of Indian Cottonseed and Oil—Part II.

S. A. SALETORÉ and V. R. HARWALKAR, Hyderabad-Deccan.

The superior keeping qualities of crude cottonseed oil were evident from the slow increase in P.V. and acid value in oil tested by shelf storage at room temperature and accelerated Swifts stability test at 97.5°C.

Some of the anti-oxidants like catechin, B.H.A. and N.D.G.A. which were tested on crude and refined cottonseed oil were not as effective as on crude and refined groundnut oil. A comparative study of the effect of different anti-oxidants on crude and refined cottonseed oil has been made.

325. Preparation of Potassium Compounds from Felspar.

ESHWAR RAJ SAXENA and D. S. DATAR, Hyderabad-Deccan.

Felspar, a potash bearing mineral which is extensively available in India can be a good source of potassium compounds. Processes, to prepare potassium hydroxide, sulphate, chloride, nitrate and bromide and potash alum, based on the study of the reactions of felspar by the authors, have been described. White Cement, good quality sludge bricks and active silica are the other valuable products.

326. A note on the Asbestos Cement Sheet Industry in India.

ESHWAR RAJ SAXENA, MIR NOMAN KHAN and D. S. DATAR,
Hyderabad-Deccan.

The current annual production of asbestos cement sheets in India is about 110,000 tons per annum. About 15,000 tons of asbestos of chrysotile variety required in the manufacture of asbestos cement sheets is imported from Canada.

and Rhodesia. The annual production of asbestos in India in the last five years has been only 200-800 tons, out of which less than 200 tons consist of medium and long fibre which could be useful in making asbestos cement sheets ; this is negligible when compared to the actual requirements in the asbestos cement sheet industry.

In view of the fact that the imports of asbestos cannot be reduced to any appreciable extent, it is suggested that instead of importing costlier variety of chrysotile asbestos, amosite asbestos, which is available at about half the price may be imported and used.

It is reported that cracks develop in the asbestos cement sheets when amosite asbestos is used. A method has been worked out in our laboratories to get over this defect. The sheets prepared according to this process, do not develop cracks and satisfy the required specifications.

327. Synthesis of n-Propyl Vinyl Ether from Acetylene and n-Propyl Alcohol in the Vapour Phase.

S. N. SEN and S. K. BHATTACHARYYA, Kharagpur.

In continuation to our studies on the synthesis of various alkyl vinyl ethers, investigations have been carried out on the catalytic synthesis of n-propyl vinyl ether from acetylene and n-propyl alcohol in the vapour phase.

Catalysts, e.g. KOH, NaOH, potash lime, etc., which were found to be highly active in vinylation of methyl and ethyl alcohols have been tried. The conversion percentage on the basis of input propanol has been found to pass through a maximum with increase in reaction temperature. Higher space velocity shows a drop in yield.

Using a catalyst, containing 50% KOH by wt., supported on active charcoal, a conversion of 11.6% of propanol to propyl vinyl ether has been obtained at a temperature of 256°C and a space velocity at 156.3 lt/hr/lt of catalyst volume, when the ratio of acetylene to alcohol was 1 : 2.59.

328. Some Studies on the Factors involved in the Hydration Method for Evaluation of Cure.

S. N. SEN, C. S. NANDY and B. M. DAS, Madras.

When hides and skins are put in soak water or lime liquor swelling and hydration take place. The former is due to the osmotic pressure exerted by the diffusible ions inside and outside the hide whereas hydration is due to binding up of water by the secondary valency of the protein molecule of the hide. In the latter case water enters the protein molecule and remains there under pressure. This leads to the sum total effect of diminution of the volume of the hide water system which can be measured by the fall of water column in a dilatometer. Similarly dehydration is indicated by the release of bound water which shows an increase in the volume of the system.

Hydration in aqueous sodium is a characteristic property of hides and skins but dehydration occurs only, when there is some disruptive chemical or bacteriological actions on them. Excluding the possibility of chemical action in soaking, dehydration could only be caused there by bacterial action. The extent of hydration and the speed of subsequent dehydration would therefore indicate the state of bacterial action in the system. As such studying this process and envisaged to give a method, which is based on fundamental physico-chemical laws, for evaluating the efficiency of curing process. In an attempt to elaborate the process to the point of practical applicability it was however found that hydration and dehydration also depended on the salt and moisture content of the

sample of hide. Lower the concentration of NaCl quicker the hydration and dehydration set in and so also with initial moisture content. So for evaluating the method, dry hides should not be compared with salted hides nor salted hides with wide range of salt content be taken together for comparison.

329. Catalytic activity of some clay adsorbents.

MANIK LAL SEN GUPTA, Calcutta.

Acidic clay adsorbents like Superfiltrol, Tonsil and Kashmir bentonite, decompose the peroxides in groundnut oil during bleaching; neutral clays like Fuller's earth and Fulmont do not cause such decomposition. With this background, it has been further demonstrated that Superfiltrol is more active a catalyst in the decomposition of hydrogen peroxide than Fuller's earth. The activity in case of Superfiltrol is reduced by alkali treatment, and in case of Fuller's earth, is increased by acid treatment. Similar trends have been observed in the decomposition of peroxides in oil. The analogy, however, cannot be extended too far, since some acidic clays fail to decompose hydrogen peroxide although they will appreciably decompose the peroxides present in oil.

330. Electrodeposition of Chromium-Molybdenum Alloys.

S. C. SHOME, Calcutta.

Alloys of chromium and molybdenum, containing small amounts of the latter metal, were deposited from the solutions prepared by dissolving varying amounts of molybdic acid to the standard chromium plating solution. Bright, semi-bright and dull deposits of the alloys were obtained; the dull metallic plates became bright after polishing. The optimum conditions for the deposition of the alloy were determined. An alloy containing 1.7 per cent of molybdenum was deposited from a bath containing 400 g/l CrO_3 , 360 g/l H_2MoO_4 and a small amount of H_2SO_4 to make the SO_4/CrO_3 ratio equal to 1/100, at a temperature of 40°C and a current density of 1 amp/sq. in. The deposits which were formed at the higher current densities, contained higher percentages of molybdenum and some oxygen.

331. Fusel oil of Hyderabad State and its utilisation.

L. M. SRIVASTAVA and C. C. REDDY, Hyderabad-Dn.

The Nizam's Sugar Factory in Hyderabad State produces about 1500 gallons of fusel oil per year with a further anticipated increase in production of 2500 gallons in the near future. Several samples were collected during different seasons and fractionated. While the composition differs from sample to sample the average composition of the fusel oil was as follows:

Ethyl alcohol 6.8%, isopropyl alcohol 4.6%, n. propyl alcohol 0.5-1%, water 6.8%, isoamyl alcohol 60-70%, higher alcohol 5-7%.

Since repeated fractionation is essential for obtaining pure isopropyl alcohol and butyl alcohols due to the presence of water and ethyl alcohol, the lower fractions were extracted with saturated salt solution to remove ethyl alcohol and water and redistillation yielded fractions with sharp boiling points. Pilot Plant experiments were also carried out in an all-glass Quickfit fractionation unit of 25 litre capacity with a 3 ft. high column.

Starting from pure isoamyl alcohol, isoamyl nitrite, isoamyl acetate, isoamyl butyrate, isoamyl benzoate and isoamyl salicylate were prepared in good yield using standard methods.

332. Rectification of palmarosa oil of low geraniol content.—Part I.

L. M. SRIVASTAVA and S. H. ZAHEER, Hyderabad-Dn.

India holds an important position with regard to the production of palmarosa oil which is the main source of high quality geraniol employed in all important formulations in perfumery and the soap industry. From the commercial point of view the most important regions in which the oil is produced are Madhya Pradesh, Bombay and Hyderabad Deccan. The oil produced in Madhya Pradesh is of the best quality possessing a sweet rosy note and a high total geraniol content while the Hyderabad oil has a low geraniol content about 60-70%.

Since Hyderabad produces the bulk of the oil exported attempts were made to rectify the oil by vacuum and steam distillation on a laboratory scale to step up the geraniol content of the oil to 90%. Due to the relatively high cost of the equipment required for a large scale vacuum distillation unit and also because of the formation of polymerised residues (about 6%) rectification with steam distillation was studied and the oil separated into three fractions: (1) oil rich in terpenes, (2) oil containing mixture of geraniol and terpenes, (3) oil containing 90% geraniol. Pilot plant studies were made of the process and about 7,000 lbs. of the oil of different compositions were rectified according to the method developed yielding oil of 90% geraniol content suitable for export.

333. Effect of Clay on the thermal decomposition of Calcium Carbonate.

B. V. S. SUBBA RAO and ABDE ALI, Hyderabad-Deccan.

With a view to ascertain the possible effect of the presence of clay impurity on the thermal decomposition of limestone the reaction between clay and Calcium Carbonate was studied. The alumina in the clay calcined at 900°C for 3 hours is only slightly soluble in acid but it is rendered soluble when clay is heated with Calcium Carbonate prior to the extraction with acid. The optimum molar proportion when clay is in excess works out to be clay : Calcium Carbonate : : 1 : 1.

334. Electrodeposition of Tin-Zinc Alloys from Pyrophosphate Bath.

J. VAID and T. L. RAMACHAR, Bangalore.

A new type of bath has been developed for the plating of tin-zinc alloys of any desired composition. The bath consists of tin, zinc and sodium pyrophosphate with gelatin as addition agent. Good quality deposits have been obtained at current densities up to 30 amp/sq. ft. at high electrode efficiencies.

335. Motion of Liquid Drops in Immiscible Liquids.

D. VENKATESWARLU and P. M. KRISHNA, Kharagpur.

A knowledge of the terminal velocity of liquid drops in immiscible liquids is essential for the design of liquid-liquid extractors and the equipment in which contact between liquid phases is secured by dispersing one of the phases as drops in the other phase so as to increase the interfacial area and thereby the rate of mass transfer. As the shape of liquid drops is not rigid, spherical or ellipsoidal, it is not possible to get any mathematical solution for the motion of liquid drops, as in the case of solid particles of definite shape moving in a liquid and hence suitable experimental methods must be adopted.

To get the data on the motion of liquid drops in immiscible liquids, a six inch square column, six feet in height is constructed out of Perspex sheets with a structural support of $\frac{1}{2}'' \times \frac{1}{2}''$ aluminium angles. A number of liquids of widely varying physical properties (density, viscosity and interfacial tension) characterised by their P numbers and Sd values are selected. The time taken for the fall of drops of different sizes of these selected liquids are recorded. The Reynolds Numbers and Drag Coefficients of these drops are determined from the diameters and the terminal velocities of the drops and plotted. A critical examination of the plots is made. An attempt to correlate the experimental data and to define the motion of drops in terms of the physical properties of the liquids is presented.

GEOLOGY AND GEOGRAPHY SECTION

President :—SHRI A. M. N. GHOSH, B.Sc. (Hons.) (Lond.), A.R.C.S.

Abstracts

A. GEOLOGY

(i) Stratigraphy and Structural Geology.

1. A New Find of Agglomeratic Tuff in Bundelkhand Granite area in Chhatarpur District, V.P.

A. G. JHINGRAN and S. N. PURI, Calcutta.

The paper describes a new find of agglomeratic tuff near Angor ($24^{\circ} 44' : 79^{\circ} 25' 50''$) in Chhatarpur district, Vindhya Pradesh. The occurrence is all the more important since it is in a purely Bundelkhand granite country although, unfortunately, the contact of the two is not exposed.

The rock is mainly composed of serpentinous material which is dissected by a network of calcareous veins. Small crystals of chrysotile and antigorite are also recognisable, within the serpentinous mass.

This rock is very closely similar to the diamondiferous agglomeratic tuff from Majhgawan, Panna district, in hand specimens as also under microscope. Detailed lithological and petrographic account of the rock has been described in the paper.

2. Some interesting features of a Felspathic Grit in the Bijawars, Chhatarpur District, Vindhya Pradesh.

A. G. JHINGRAN, K. NARAIN and S. N. PURI, Calcutta.

The paper deals with a peculiar rock in the Bijawars which is conglomeratic in character and has a matrix with a granitic appearance. The enclosed masses are dominantly made of quartzites and veins quartz, a few being of granite also. Although in some cases they have a sub-rectangular outline, most of them are pebbly and are only held weakly by the matrix, tending to fall off readily under influence of mild hammering. The density of these pebbles varies considerably from place to place. The matrix, under the microscope is holocrystalline, the constituents, quartz and feldspars being subhedral in character, and interlocked with one another in the usual granite fashion.

On tracing the rock laterally along the strike as also upwards in the section it is found to merge into felspathic grits or quartzites. It is thus obvious that it is only a lateral variation of the felspathic grit in which the matrix has acquired a granitic texture in place of the original granular character. It may thus be considered to be illustrating the phenomenon of granitisation of arkose sediments.

3. Metabasites near Hura and Manbazar, Manbhum District, Bihar.

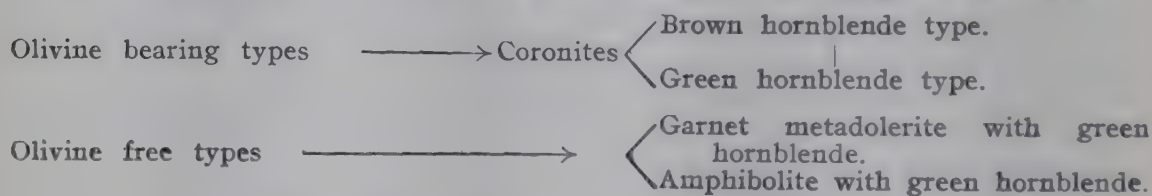
T. M. MAHADEVAN, Calcutta.

The paper describes the metabasites occurring in the gneisses around Hura ($23^{\circ} 16' : 86^{\circ} 40'$) and Manbazar ($23^{\circ} 03' : 86^{\circ} 40'$) over an area lying between

Lat. $23^{\circ} 03'$ and $23^{\circ} 20'$ and Long. $86^{\circ} 38'$ and $86^{\circ} 45'$. These occur as small sheet-like bodies or as larger masses with irregular but apparently concordant boundaries with the gneisses. They may be classified into two mineralogically different types, the Olivine-free and Olivine-rich types. Among the former there are two groups—an earlier group of metagabbros and amphibolites and an younger group of meta-dolerites cutting across the former. These are mineralogically similar and consist of plagioclase (labradorite) and augite, which are in different stages of alteration to green hornblende, magnetite and sphene. The older group of metabasites are more intensely altered and have recrystallised completely into amphibolites in places. The felspars in the younger group of dolerites are generally intensely clouded, this feature being absent in the earlier gabbros and amphibolites. North of Lat. $23^{\circ} 30'$, these younger dykes develop small granules of garnet whereas south of this latitude they are garnet free.

The olivine-rich types are generally gabbroidal in texture and are also in different stages of alteration to amphibolites. The least altered portions consist mostly of olivine, titanite (?) or augite, hypersthene, brown or green hornblende and plagioclase. The plagioclase and augite and occasionally olivine show "clouding".

The trends in the alteration of the metabasites may be represented as follows :—



4. On the occurrence of pyroclastics in the Lower Gondwanas of Assam Himalaya.

T. BANERJEE, Calcutta.

The paper describes in detail the occurrence of an extremely fine grained, structureless silicious tuff in undoubted Lower Gondwana boulder slates in a tributary of the Belsiri river in the Outer hills of the Kameng Frontier Division of the North-East Frontier Agency. The band, about three furlongs wide, is bedded and fractured and occupies a stratigraphical position immediately above the boulder slates which are equivalent to the Talchir boulder bed of the Indian Peninsula. Recently, a band of bedded and fractured agglomeratic slate, was observed near the base of the Lower Gondwana of the foothills belt in a right arm tributary of the Lish river, near the deboucher of the Tista river, roughly 200 miles west of the Kameng section. The occurrence of pyroclastics in this part of the Gondwana is reminiscent of the similar conditions existing, though on a much larger scale, in the Kashmir Himalaya during this period which resulted in the formation of the Panjal Agglomeratic slates. The Abor volcanics of Coggin Brown also belong to a same stratigraphic horizon and it may be possible some day to prove the existence of volcanic activity during the Permo-Carboniferous times more or less in an un-interrupted stretch from the Kashmir to Assam Himalaya.

5. A Palaeogeographic Study of the Vindhyan Period.

F. AHMAD, Calcutta.

The Vindhyan Range has played a very important part in the history and strategy of the country and received early attention from geologists. Yet no general

or regional stratigraphic study of the Vindhya System has ever been carried out. The present paper attempts this in the light of modern knowledge of sedimentation and tectonics. The conclusions arrived at are exceedingly interesting.

Contrary to earlier belief, it appears that, except for a small southern strip, no part of the Gangetic Valley, is underlain by Vindhyhan rocks. Apparently the area was part of an extensive Craton, herein called the Aravalli Craton. Sediments now seen in the Vindhyan formations were largely derived from this and so were; probably, the diamonds in the conglomerates near Panna. The author does not believe that the Aravalli Range stood as a mountain system at the time nor was the Western Rajputana Basin altogether independent. There is distinct evidence of simple epeirogenic movement all over the country. It is concluded that a large river flowed into the Vindhyan Basin near Rohtasgarh and had its origin somewhere in N.E. Assam. This river has been named the Auden River. Sometime in the Kaimur age a new basin was formed in S. E. India and it probably overlapped extensively. Its extent and connections are, however, not clear yet.

The paper takes note of the two glacial horizons reported from the Vindhyan System in recent years and suggests that apparently the Son Valley escaped the ice cap. A Tundra climate comparable with the present conditions of the Ob, Yenisei and Lena basin, and occasionally a freshwater lake in which the Susnai 'breccia' was formed out of rafted material, is envisaged.

The Chhattisgarh Basin beds are here correlated with the Vindhyan System and a general correlation with the Nullagine Series and the Sturtian Series of Australia, and the Karagwe System of Central Africa is suggested. It is significant that the Nullagine Series also carries a tillite at the base and a diamondiferous horizon higher up. This is taken to indicate a former proximity of the two continents.

6. Evolution of the Structures of the Metamorphites and the Granitic Assemblages Around Kudada, Singhbhum District.

DIPAKKUMAR RAY, Calcutta.

The sedimentary metamorphites of the Iron Ore Series, the Singhbhum granites and the Soda granites around Kudada ($86^{\circ} 12' 30''$ E; $22^{\circ} 42' 30''$ N) are structurally similar. Their structural features have been analysed in the following text.

The types of schistosity observed are (i) S_1 —bedding; (ii) S_2 —axial plane cleavage; (iii) S_3 —axial plane cleavage in the drag folds in b ; (iv) S_4 —axial plane cleavage in the puckerings in a ; and (v) S_5 —the transposition schistosity in the phyllonites. Neomineralisation of chlorites and sericites along all of these planes is universal.

The lineations observed are (i) L_1 —axes of the drag folds in S_1 — b lineation; (ii) L_2 —striations on S_1 — a lineation; (iii) L_3 —parallel needles of sericite in the down dip direction— a lineation; and (iv) L_4 —axes of puckering normal to the axes of the drag folds— a lineation. The a lineation is associated with bc girdles, but a few phyllonites still retain the relict ac girdle with lineation in b .

The joints observed are as (i) Cross (ac tension) joints; (ii) diagonal shear joints; (iii) longitudinal (bc tension) joints; (iv) longitudinal shear joints dipping away from the foliation; and (v) fine ac tension joints

The sequence in the evolution is as :

- (i) Regional Folding— S_1 — S_2 — L_1 —cross joints—diagonal shear joints;
- (ii) S_3 — L_2 — S_4 ;
- (iii) longitudinal tension joints—longitudinal shear joints; and
- (iv) L_4 — S_5 —fine ac tension joints.

7. Some Structural Studies of the Porphyritic Granite around Muri, Ranchi District, Bihar.

NIRANJAN DEB CHATTERJEE, Calcutta.

Structural studies of a part of a band of porphyritic granite around Muri has been carried out in considerable detail. The granite has intruded the strongly folded metamorphic superstructure mainly along the structural planes forming a steep-walled sheet-form intrusive.

The granite shows primary planar and linear structures. The foliation in the granite and in the wall-rocks both trend roughly E-W. The lineation in the metamorphics usually plunge at low angles to E or to ENE, while that in the granite plunge constantly to the W at low to moderate angles.

Two sets of joints have developed in the wall-rocks, which bear genetic relation to this intrusion. They wane out rapidly away from the contact. Their formation are attributable to the effects of the pressure due to the intrusion of foreign materials, followed by an all round expansion of the chamber to accommodate it.

Fabric investigations have been undertaken to test the conclusions arrived at from the field studies alone.

Two specimens away from the contact in the wall-rocks show *ac* girdle with maxima I, II and V in the quartz-fabric; and a strong maximum at *c* with minor spread in the *ac* zone in the mica-fabric. Two specimens of the wall-rocks from near the contact give *ac* girdle with a distinct spread in the *bc* zone with maximum I and sub-maxima II and V in the quartz-fabric; while the mica-fabric show strong maximum at *c* with slight spread in the *bc* zone.

Four specimens of porphyritic granite collected from different distances inwards from the contact has been studied. In sections cut perpendicular to the lineation, the quartz-fabric show an incomplete peripheral girdle in the specimen nearest to the margin. The second specimen shows a deterioration of this girdle, while in the third and fourth specimens taken from well inside the granite no readily recognisable pattern can be seen. The mica-fabric show a strong maximum at the pole of the foliation with minor spread in the zone of the section in one specimen, while in the other it shows a complete peripheral girdle.

Difference in the orientation of the girdles in the wall-rocks and in the granite suggest structural independence of the latter and support the conclusions arrived at from field studies.

8. A Note on Geology of the Area Around Muri-Silli, Ranchi District.

DILIP KUMAR SEN GUPTA, Kharagpur.

The paper deals with the geology of the Muri-Silli area which is a part of Chotonagpur granite-gneiss terrain. The Archaean rocks consist of granite-gneisses migmatites, granites with pegmatities and aplites, and metamorphites including psammitic, semi-pelitic, pelitic, para-and ortho-hornblendic rocks.

The schistosity and foliation (S_2) of the metamorphites and granite-gneisses generally show east-west strike with vertical to steep dips towards north or south. The axes of minor folds plunging east or west are usually parallel to the regional strike. S_2 -plane is mostly parallel to S_1 -plane (relict primary bedding and banding) in the metamorphites except near the fold axes. Relicts of minor bands and lenticles of psammitic, pelitic and hornblendic rocks within the granite-gneisses have the same east-west strike as the major band of similar metamorphites which extends ten miles bordering the granite gneisses on the north suggesting granitization *in situ*.

Granite-gneisses including augen gneiss, porphyroblastic gneiss, banded gneiss and biotite-gneiss appear to have been formed by the granitization of the country

rocks followed by local mobilization resulting in pygmatic folding etc. In most cases foliation has been controlled by the pre-existing schistosity or banding in the metamorphites. Both replacement and displacement types of pegmatites are found to occur as the last phase of granitization.

9. The serpentinites of Mysore and their Relation to the Geological Structure of the State.

C. S. PICHAMUTHU, Bangalore.

The chromiferous ultrabasic rocks of Mysore State occur in a well-defined narrow zone running in a N.N.W. to S.S.E. direction, through the Shimoga, Hassan and Mysore districts. The ultrabasic rocks are mainly serpentinites with occasional harzburgites, peridotites, dunites and some types of schists. The serpentinite bodies generally conform in trend to the strike of the schist belt, and are steeply dipping. They are not continuous but occur in disconnected patches and lenses of varying dimensions.

A few years ago, the present writer suggested that the Dharwar schist bands of Mysore State represent the remnants of a big anticlinorium plunging N.N.W. (*Curr. Sci.*, 20, 1951, pp. 117-119). The ultrabasic belt of Mysore is seen to occupy the axial plane of this fold and belongs, therefore, to the "alpine types". It affords a good example of the connection existing between igneous intrusion and orogenic deformation.

A sketch map is given to illustrate the relationship between the ultrabasic belt and the Dharwar anticlinorium.

10. A Note on the Sedimentary Hornblende-schists of Gurpa, Gaya District, Bihar.

B. DASS, Kharagpur.

The hornblende-schists, discussed in this paper, consist essentially of hornblende, quartz, plagioclase, sphene and iron-ores in varying proportions, with garnet, rutile and biotite as possible minor additional constituents. Their sedimentary origin is indicated by (i) the presence of relict sedimentary bedding, (ii) interbanding of different compositional layers varying in thickness from 1/30th of an inch to several feet, and their extension along the strike, (iii) traces of cross-bedding, and (iv) resemblance with the sedimentary hornblende-schists of classic areas regarding mineral-assembly and texture. In general these schists appear to be derived from interbedded impure calcareous and siliceous sediments by medium to high grade regional metamorphism.

The most conspicuous structural elements are the primary bedding (S_1 -plane), and the secondary schistosity (S_2 -plane), developed as a result of metamorphism, which is more or less parallel to S_1 -plane, except near the minor fold axes. The lineation due to preferred dimensional orientation of hornblende and quartz is parallel to S_2 -plane and is mimetic in nature. On the whole the hornblende-schists resemble mimetic-tectonites.

11. A Preliminary Note on the Geology around Gudma, E. Bhandara District, M.P.

V. B. GODSE, Banaras.

The area surveyed forms a small portion of Tirora tehsil, Bhandara District, M.P. and is represented in the Survey of India map No. 64 C/7. The present survey was carried out in the field season of December-January 1954-55.

The country rocks are gneisses and schists, exposed in the low-lying areas in the southern portion. The general strike of the rocks is NE-SW. Other rock types are granites, quartzites, feldspathic-quartzites, quartz veins, amphibolites, hornblende-schists and the actinolite-schists. Further, two rocks of economic importance, banded hematite quartzite and laterite occur in the southern and northern parts of the area respectively. The former is about a furlong and a half in length, a furlong in width and 250-300' high. At the top, the ore (hematite) is of poor quality; but at about a depth of 10' it is excellent, as seen in some of the working pits on the west of the hill. The laterite deposit is about 8 feet thick. The quality is poor but is useful as a building material in the form of slabs and blocks.

The oldest rocks in this area include gneisses, schists, banded hematite quartzite and argillite which can be correlated with the Sakoli and Chilpi series of the Middle Dharwars. These were later intruded by basic rocks now represented as amphibolites, hornblende-schists, and actinolite-schists and still later by granite and its post-magmatic counterparts.

12. Geology of the area around Matari, Manbhum District, Bihar.

T. N. NARASIMHAN, Dhanbad.

The paper is a preliminary report on the metamorphic terrain of Archaean rocks around Matari, which was geologically mapped recently on a scale of 4" to a mile. The strike of the country rocks is N.W.—S.E. with a dip varying from 45° to 85° towards N.E. The axes of the minute crumplings seen in these rocks are all generally parallel to the strike of the country rocks.

On the basis of the age relationships among the various rock types studied in the field and taking into account their lithological composition, relationship to the igneous activity, degree of metamorphism, the rocks have been tentatively classified and arranged in a sequence.

Structurally the area is quite interesting. There is a pitching syncline near the village *Manpur*. The area, especially the southern half, is traversed by numerous quartz filled faults. All these are high angle normal faults. The quartz material filling up these fault zones exhibit various structural forms like platy structure, honeycombed structure etc. The occurrence of quartz felsite dykes in the area has added importance to the geology as similar ones have been recorded in the metamorphites of the neighbourhood by Agrawal and others.

13. The Structure and Stratigraphy of the Upper Assam Alluvial Area.

P. EVANS, London.

The structure of the alluvial part of the Brahmaputra Valley in Upper Assam has been investigated by extensive geophysical surveys and by deep bore-holes. The alluvium and underlying Tertiary beds conceal the north-eastern prolongation of the Indian Shield (to which the Shillong Plateau and Mikir Hills belong); the area is flanked on the north-west and on the south-east by overthrust sheets which are the result of late Tertiary (and even Quaternary) movements. Apart from the immense thrusts, with displacements measured in miles, there are (at least on the south-eastern flank) remarkably few faults. The area between the two opposing groups of overthrusts exhibits a quite different type of structure. It is crossed by innumerable faults, small and large, which appear to have little hade (in contrast to the high hade of the overthrusts in the hills). The Tertiary sediments are thus cut up into a jigsaw of small blocks within which the dip is extremely variable in direction, although usually quite small in amount. The structure can be compared with the fault structures of the Shillong Plateau and Mikir Hills, and the

evidence indicates that the movements have continued intermittently throughout much of Tertiary and Quaternary times. Throughout the whole sedimentary column there is much lateral variation—changes in thickness, beds lensing out, and modifications of lithology.

The exploration of this type of structure by seismic surveys is slow and expensive, and the detailed investigation of the seismic results presents many difficulties. The interpreter is for the most part working at the extreme margin of the capabilities of the seismic method, and it is commonly found that more than one interpretation is possible.

In the succession proved by drilling, the uppermost few thousand feet are pebble-beds and sands belonging to the Brahmaputra alluvium and the Pliocene Dihing Series. Below them come the Miocene Girujan Clays, which pass down into the Tipam Sandstone. Beneath an important unconformity comes the Barail Series (Oligocene), the lowest group penetrated by the drill. The basement rocks are presumably metamorphic and igneous rocks similar to those of the Mikir Hills and Shillong Plateau.

The oil found at Nahorkatiya occurs in sands in the Barails, a formation containing both marine and freshwater beds. The Barails exhibit bewilderingly rapid lateral variation, making detailed correlation between wells uncertain.

14. On the Basic Igneous Intrusives around Jojohatu, Singhbhum, Bihar.

K. K. SINGH, Kharagpur.

The occurrence of basic intrusives scattered all over the western parts of Chaibasa area around Jojohatu ($22^{\circ} 31' : 85^{\circ} 38'$) has been noted during the detailed geological survey of the ultrabasics and associated chromite deposits. In this paper a brief resume of the field, petrographic and petrogenetic characters of these basic intrusives is given. A map showing the details of the occurrences of these intrusives is appended.

The basic intrusives occur as sills and dykes in the shales of the Iron Ore series, in the ultrabasics and in the associated smaller patches of granites. They vary in mineral assemblage, texture and degree of metamorphism. The intrusives are in general, quartz-dolerites, though at times olivine-dolerites and gabbroidal rocks are met with. The typical basic rocks show micropegmatitic intergrowth between primary quartz and feldspars, with partly uralitised clino-pyroxenes and saussuritised plagioclase set up in an ophitic texture. The imprint of metamorphism is low as indicated by mineral assemblage. The alteration is more pronounced in the sills occurring in the shales possibly due to difference in the environmental set up.

The basic intrusives appear to be contemporaneous and are equivalent in age to the Newer Dolerites of Singhbhum District. Further work on the study of the basic intrusives in this district will help in the better understanding of this younger basic igneous activity, its consolidation and metamorphism.

15. Geology of the area around Kantadih, Manbhum District, Bihar.

DEBDUTTA MUKHERJEE, Calcutta.

The Archaean terrain around Kantadih ($86^{\circ} 15' - 86^{\circ} 20' \text{ E} ; 23^{\circ} 8' - 23^{\circ} 15' \text{ N}$) consists of granite rocks and of those like amphibolites, pyroxene-granulites and meta-dolerites. The granitic rocks, including normal granite and granite-gneiss, leuco-granite, granodiorite, porphyritic granite and migmatitic granite are correlated with Chotanagpur granite-gneiss. The gneissose rocks show their foliation planes dipping at high angles towards NNE. The amphibolites are found as

streaky inclusions trending E-W. Towards the contact with amphibolite inclusion, the granite shows marked increase of biotite and amphibole content. With thorough permeation of granitic materials migmatitic granites have been formed. The amphibolite comprises plagioclase (labradorite) and hornblende with sphene, zoisite and iron-ores as accessories. The garnetiferous amphibolites are also observed. In some cases amphibolites are found occurring side by side with pyroxene granulites and in thin sections the transformation diopside \rightarrow hornblende shows that the amphibolites are due to retrogression of pyroxene-granulite. The meta-dolerites occur as lensoid masses consisting of plagioclase and uralitised augite as primary constituents together with iron-ores as accessories and show relief subophitic and intergranular textures.

16. Manganiferous Quartz Rocks of Denderu area, Visakhapatnam District.

C. N. RAO and S. V. L. RAO, Kharagpur.

Manganiferous Quartz rocks have been noted two miles south-east of Denderu Village ($17^{\circ} 52'$, $80^{\circ} 94'$) Viravalli taluq as small bands on the southern slopes of the hillocks interbedded with quartzites. Ores form the predominating part of the mineral assemblage with quartz, rhodonite, ferriferous enstatite and sillimanite as accessories. Microchemical tests, etch reactions and ore microscopic studies indicate that the ore minerals consist of psilomelane and vredenbergit.

These rocks show typical mineral assemblage characteristic of the products of high grade metamorphism of arenaceous sediments. The association of manganese oxides and silicates with typomorphic mineral like sillimanite and their occurrence in the quartzitic bands of the Khondalite series is highly significant in that, part of the manganese formations of Visakhapatnam district is essentially similar to Gondites of Madhya Pradesh except for the higher imprint of metamorphism of the former.

17. Occurrence of a Clastic Dyke in the Serampore Colliery, Giridih, Bihar.

C. NARASIMHA RAO, Kharagpur.

The occurrence of a clastic dyke in a quarry composed of Karharbari sandstones, about a mile south east of the Deep pit in the Serampore Colliery ($24^{\circ} 8'$: $86^{\circ} 17'$) has been noted and its detailed petrography and petrogenesis are presented in this paper. The main dyke is about 6" in width and rises to 2 feet in the gray sandstones and is probably a remnant of an originally larger dyke. The dyke material is made up of coarse black arkose, carrying sharp angular fragments of coal at the margins, derived obviously from the underlying coal seam. The dyke is faulted along its length with no apparent displacement.

The field studies indicate that the dyke might have been formed due to the injection of the underlying cial and black arkose from below, into the pre-existing fissure at the bottom of the gray sandstone, and there compacted to form the dyke. The pressure necessary for its function might have been supplied by the load of the overlying sandstones.

18. Progressive Regional Metamorphism in Argillites in the Asanbani-Ghatsila Metamorphic Belt, Singhbhum.

KSHITINDRAMOHAN NAHA, Calcutta.

In the metamorphic belt from Asanbani ($86^{\circ} 19'$: $22^{\circ} 45'$) to the east of Ghatsila ($86^{\circ} 29'$: $22^{\circ} 34'$) zones of progressive regional metamorphism from chlorite to

kyanite have been delineated in the mica-schists. The lowest grade rocks crop out in the hill-ranges north of Ghatsila, where extremely fine grained chlorite- and biotite-zone rocks occur. The major part of the belt around Asanbani, Galudih, and Ghatsila is occupied by garnet zone rocks, with a small closed outcrop of biotite zone near Ghatsila. Staurolite zone rocks occur in a small area north of Asanbani, and east and southeast of Ghatsila the intensity reaches upto the kyanite grade.

The distribution of the metamorphic zones shows a rough concordance with the structural plan of the region, with the higher and lower grade rocks occurring respectively at tectonic culminations and depressions (both in longitudinal and transverse sections). The broad, regional outcrop of the garnet zone rocks is due to tight, shallow corrugations and low plunge of fold axes, while sharp variation in grades occurs in regions with steeper axial plunge and comparatively open folds (as, for example, to the southeast of Ghatsila, where biotite to kyanite zones come in quick succession).

Thus the intensity of metamorphism appears to be closely related to the tectonic depth in the region.

19. Age of Pakhals and Sullavais of Warangal District, South India.

S. M. AHMEDUDDIN, Osmania.

Study of the elastic behaviour and structural petrology of quartzites from Pakhals and Sandstones from Sullavais, with special reference to their stratigraphical horizon is attempted.

The Pakhals have undergone intense metamorphism and are intruded by granites, pegmatites and quartz veins. The Sullavais consisting of sandstones and grits were not subjected to any appreciable metamorphic influence and are not intruded by granites.

On the basis of the petrofabric work Sandstones and Grits fall under one group exhibiting very poor preferred orientation. Quartzites and quartz-schists show very good orientation pattern having orthorhombic symmetry.

The elastic behaviour of quartzites and sandstones is studied by the wedge method developed by Dr. Bhagvantam.

On the basis of elastic and petrofabric data a stratigraphical correlation of the Sullavais and Pakhals is made. The Pakhals are shown to be regular tectonites with preferred orientation, whereas, the Sullavais have only random orientation and were not subjected to any great tectonic movement.

These detailed studies prove that the Pakhals are of Dharwar age and not the upper bed of Cuddapah age and the Sullavais of Cuddapah age and not the lowest beds of the Lower Vindhyan age.

20. Preliminary Note on the Microfabric of the Western Part of Singhbhum Shear Zone.

ANIRUDDHA DE, Calcutta.

The rocks of the western part of Singhbhum shear zone ($22^{\circ} 43' - 22^{\circ} 51'$; $85^{\circ} 45' - 86^{\circ} 0'$) show evidences of intense penetrative movement along shear planes containing lineations in *a* (viz. mineral elongation, slickensiding, striation, grooving, pebble elongation, etc.) parallel to the direction of dip and subordinate puckers and boudinage parallel to *b*. The phyllites, quartzites, conglomerates, quartz-schists and Arkasani Granophyre are all affected by the shear zone deformation. The fabric analyses show a general development of *bc* girdle of *c*-axes of quartz around the direction of penetrative movement *a*. In strongly deformed rocks the maxima in

b or the maxima III are emphasized; while in rocks showing puckerings in *b* an incipient tendency to form *ac* cleft girdle is also seen giving rise to crossed girdles intersecting in *c*. A highly mylonised quartz-schist shows a point maxima at *b* with the development of intermediate maxima II. The Arkasani Granophyre likewise shows broad *bc* girdle with strongly developed maxima III. Triaxial nature of the deformation is evidenced by the dimensions of the conglomerate pebbles. A correlation between the intensity of deformation and the degree of preferred orientation is also attempted.

21. Orientation of Deformation Lamellae of Quartz from Mahali Marup, Singhbhum District, Bihar.

ANIRUDDHA DE, Calcutta.

A feldspathic mica schist occurring south of Mohali Marup R.S. ($22^{\circ} 45' - 85^{\circ} 53'$) located on the western continuation of the Singhbhum shear zone shows very well-developed deformation lamellae of the quartz grains. Megascopically the rock shows elongated feldspar and quartz metacrysts, and striation lineation parallel to the direction of penetrative movement *a*, normal to this direction minor puckering in *b* also occurs. The *c*-axes of quartz show well-developed maxima III in a broad *bc* girdle, the direction of penetrative movement *a* is the principal girdle axis; moreover, due to the development of maxima V, II and feebly developed maxima I there is a tendency to form an *ac* girdle. The deformation lamellae are oriented in two intersecting sets. The lamellae β axes are coincident with *a* and *b* fabric axes. The measurements of the angular distance $c \wedge \perp L$ show a preferred orientation for the lamellae to form within $11^{\circ} - 22^{\circ}$ of the basal plane, hence they do not correspond with any rational crystallographic plane, this can be explained by co-operative slip along more than one rational plane as in the case of magnesium metal. The $cL \wedge cL$ values do not show any maxima at 60° but when two sets of lamellae are present in one grain the intersection line has an angular distance of 90° or so from *c*-axis of quartz or in other words the lamellae intersect in the basal plane. The pattern of the *c*-axes of quartz and their deformation lamellae show that the strain is triaxial.

22. Geology of the Eastern Part of the Son Valley, with special reference to the acid-igneous activity in the Lower Vindhya.

V. S. DUBEY and K. K. MISRA, Banaras.

The paper deals with the geology of the eastern part of the Son Valley near Churhat (lat. $24^{\circ} 27'$; longs. 81° to 82°). The beds found in the area are made up of Lower Vindhya, comprising the Basal stage, porcellanite and Kheinjua stage. At the bottom of the Basal stage, there is a bed of fine grained rock containing particles of quartz and felspar and in which are embedded a large number of angular, subangular and rounded pebbles, upto 4" in diameter, of different rocks. The bed has all the characteristics of 'tillite' and appears to have been formed by glacial action. It occupies a stratigraphic position similar to the tillite-beds of the Bijawar area, being just above the Bijawars. It is overlain by the bed of porcellanite which is composed of acid tuffs. Detailed petrological and chemical studies have shown that the tuff is formed of both altered and hybrid material and varies in size from fine to coarse grain. In chemical composition it is similar to a rhyolite. It appears that at least for a distance of 400 miles there was violent submarine acid activity in this area which led to the formation of these pyroclastic rocks, designated as the porcellanite. These extensive series of acid eruptions began just after the beginning of the Vindhyan era and is Lower Palaeozoic in age. Probably the

intrusive phase of this activity is represented in the Rajasthan in the form of Jalore and Siwana granites.

(ii) Palaeontology and Palaeobotany.

23. Microflora and age of rocks from Dharliala Well No. 1.

A. K. GHOSH and A. BOSE, Calcutta.

Six rock-specimens from different depths of Dharliala Well No. 1 have been examined. The microflora recovered, resemble those recorded from the undisputed Cambrian rocks. The age of the rocks analysed, is therefore considered to be Cambrian.

(iii) Mineralogy.

24. Mineralography of the Rajmahal Volcanic Flows in the vicinity of Simra, Santhal Parganas, Bihar

PRATIP KUMAR MUKERJEE, Howrah.

The lava flows of basaltic composition, in this region, exhibit absolute uniformity in mineral composition and are always made up of plagioclase feldspars, pyroxenes, iron ores, primary glass, palagonite, secondary silica, zeolites and calcite, of which the first four are primary constituents and the rest, secondary.

In all cases, the different minerals named above, have been examined under the petrological microscope and the compositions of the plagioclases and pyroxenes were determined precisely from a determination of their refractive indices and optic axial angles. The plagioclases form the phenocrysts and the granules of the groundmass and range in composition between An_{71} to An_{64} and An_{56} to An_{48} respectively. The pyroxenes forming the groundmass are generally pigeonites while those forming the phenocrysts are augite. The iron ores are generally magnetite and ilmenite. The primary glass is of various colours and often contains minute crystals of plagioclase and pyroxene. No olivine could be found in any of the rocks of this area. Of the secondary constituents, palagonite exhibits a number of colours with corresponding variations in the refractive indices. Secondary silica occurs in a variety of forms like chalcedony and quartz. Calcite was found to occur in one of the samples only, while zeolites, which are most probably chabazite, were found to occur in small quantities in some of the specimens.

The relative proportions of the minerals in different samples were variable within wide limits and a number of modal determinations were made in this connection.

25. A Note on the Origin of Cumingtonites in the quartzites of Southern Bababudans, Chikmagalur district, Mysore State.

N. M. MALLIKARJUNAPPA and C. GOPALASWAMY RAO, Bangalore.

An interesting occurrence of black coloured amphibole later determined to be cumingtonite has been noticed in an outcrop of quartzite situated between 3/18th and 4/18th furlongs stones along Chikmagalur-Narasimharajapura road in the Southern Bababudans, north-west of Chikmagalur town. The field and laboratory investigations have shown that the mineral is of secondary origin, having been derived

from the blue-green hornblende of the adjacent basic traps. The nature of the mineral and the probable trends of development of the cummingtonite are described in this note.

26. Ore Microscopic Studies of the Magnetite Ores of Dublabera, Singhbhum District.

T. C. BAGCHI and S. V. L. RAO, Kharagpur.

Magnetite ores usually containing appreciable quantities of Vanadium occur in association with the gabbroid rocks near Dublabera ($20^{\circ} 29' : 86^{\circ} 17'$), Singhbhum District. Mineragraphic studies of the opaque mineral constituents of rocks and ores have been made and the summary is now presented in this paper. The scope of this study has been limited to the identification of mineral assemblage, fabric and its genetic significance.

The ores are essentially made up by magnetite and ilmenite with haematite, rutile, different hydroxide minerals of iron, pyrites, chalcopyrites and covellite as accessories. The textures exhibited by ilmenite and magnetite have been classified as due to exsolution and segregation processes. In the former type the nuclei appear to be structure sensitive and is formed earlier than the segregation textures. Slip band intergrowths have also been identified. Secondary replacement and colloform textures are described in detail.

The exsolution intergrowths observed in pyroxenes and ores and the occurrences of coarse pegmatitic gabbros indicate a slow cooling thermal history of the magma. The bent and curved feldspars, and the slip band intergrowths in ores favour the 'late magmatic gravitative accumulation hypothesis' presented by Bateman to account for the formation of these deposits.

27. Textural Evolution in Kishengarh (Rajasthan) Ilmenites.

S. RAYCHAUDHURI and SUPRIYA ROY, Calcutta.

Studies in polished sections of Kishengarh ilmenites have furnished interesting textural relationships of ore minerals leading to an understanding of their mode of formation. Primary textures include crystallographic intergrowths of ilmenite-magnetite and ilmenite-haematite where exsolution lamellae of both magnetite and haematite are regularly orientated in the (0001) direction of ilmenite. The haematite lamellae seem to be of two generations, the first comprising coarse spindle-shaped lamellae while those of the second are extremely fine. The extinction of ilmenites and the haematite lamellae in them is parallel and simultaneous. The secondary textures recognised are the martitisation of magnetites and the alteration of ilmenite, magnetite, haematite and martite by goethites. Evidently the crystallographic intergrowths originated in falling temperature conditions by unmixing. They formed from a solid solution richer in TiO_2 , but having at the same time sufficient Fe O and Fe_2O_3 . After the magnetite blades exsolved, with further lowering of temperature progressive unmixing of haematite spindles proceeded and its second generation lamellae intergrown till limiting concentration of Fe_2O_3 in ilmenites was reached. The orientation of the exsolved lamellae in ilmenites is attributed to the fact that in both crystal structures of ilmenite and haematite, every third plane parallel to the base is an O-plane which is shared between the minerals in intergrowth. In magnetite every third and seventh (111) plane is an O-plane which is shared by every third (0001) plane in ilmenite. The textures indicate that in ilmenites, magnetites exsolved first only to be followed by haematites of the two successive generations. Later martitisation of these magnetites preceded the formation of goethites by subsequent hydration.

28. Ore Microscopic Studies of the Titaniferous Magnetites of Nausahi, Keonjhar District, Orissa.

SUPRIYA ROY, Calcutta.

This paper deals with the ore microscopic study of the vanadium bearing titaniferous magnetites which occur as lenses within the Anorthosites near Nausahi, Keonjhar District, Orissa. The ore minerals, identified by optical criteria, etch reactions and reflecting power, are : Magnetite, Ilmenite, Haematite and Martite, Goethite, Chalcopyrite and Pseudobrookite. In spite of the presence of vanadium in these ores no coulsonite could be detected anywhere in the specimens. The textural relationships of the ore minerals have been described under two headings : Primary and Secondary. The primary textures comprise crystallographic intergrowths of magnetic and ilmenite and ilmenite and haematite. These intergrowths have originated by unmixing in decreasing temperature condition. Moreover, the atomic structure and ionic dimensions are also alike in the cases of the minerals involved. In both the intergrowths the members share the oxygen planes which lie, in the case of the magnetite in every third and seventh plane parallel to (III) and in the case of the ilmenite and haematite, every third plane parallel to (0001). In the secondary textures those formed by alteration and replacement are included. Martitisation of the magnetites along grain boundary and octahedral plane, hydration of magnetite and haematite to goethite and oxidation of ilmenite to pseudobrookite are included here. The paragenesis of the ore minerals has been drawn from oldest to youngest as follows :—Magnetite-Ilmenite intergrowth, Ilmenite-Haematite intergrowth, Martite and Pseudobrookite, Goethite.

29. Selection of Diamond Bits for Core Drilling.

MILAN KUMAR SEN, Calcutta.

Amongst the various factors in diamond drilling for prospecting, foundation testing or subsurface investigation work, the relation between the textural features of rocks with the efficiency of diamond bit has been dealt with.

Statistical study of the mechanical analysis of the rocks drilled, together with shape analysis of the grains reveals the important reflection of these characteristics on the grade, shape and stone size per carat of the diamonds set in the bit with matrix of hardness varying from 5 to 60 (Rockwell 'C' scale). The relation between the physical properties of the rock forming minerals (i.e. hardness, toughness, cleavage, fracture etc.) as well as the bulk characteristics of the rock as a whole, and the performance of diamond bit have been noted. Application of these techniques, and proper use and care of both drills and bits will result in lower drilling cost per foot.

Efficiency of diamonds as an abrasive medium runs in proportion to their quality when they are properly applied. The complete range of rock formation can be drilled with maximum efficiency when the complete range of diamonds, as produced by nature, is available. In practice the range of diamonds available is, for one reason or another, limited; and this has been one of the factors contributing to slow development.

30. Ore-Microscopic Studies of Magnetite near Kudada, Singhbhum district.

BANKIM MUKHERJEE and SUPRIYA ROY, Jadavpur.

Magnetite occurs as isolated deposits near Kudada village, (22° 42' : 86° 12') 4 miles to the S.S.E. of Tatanagar Railway Station. The main country rocks are

mica-schists and phyllites, but magnetite occurs associated with highly altered ultrabasic igneous rocks and chlorite-schists.

The ores which are granular to compact, sometimes with idiomorphic crystals, were polished and studied under the reflected light and several minerals were conclusively identified by optical characters, etch reactions and reflectance measurements by Berek Slit Micro Photometer, under green light. The minerals are Magnetite, Ilmenite, Chalcopyrite, Martite and Goethite. Magnetite is the predominant mineral and next in abundance comes Martite and Goethite. Only a few grains of Ilmenite were found. Chalcopyrite occurs in very minute grains and could only be identified under high magnification. Due to its very small size the reflectance measurement was not possible. The reflectance percentages for other minerals were as follows : Magnetite 20.8, Ilmenite 18, Martite 24, Goethite 17.

As for the mineral paragenesis, magnetite was the earliest formed mineral together with ilmenite, both showing mutual boundary relation. Martite being an oxidised product of magnetite comes next to be followed by goethite, which is a hydrated form of magnetite and martite. Chalcopyrite could not be placed anywhere for its lack of relation with any other mineral.

31. Ore-microscopic Study of the Tungsten-bearing minerals, occurring in the neighbourhood of Chandapathar, Bankura district, West Bengal.

S. DEB, Jadavpur.

Tungstan-bearing minerals occur in the neighbourhood of Chandapathar ($20^{\circ} 15' : 86^{\circ} 45'$) in the Bankura District of West Bengal. The place is situated at a distance of about 35 miles from Jhargram and 25 miles from Gidni on the Calcutta-Bombay line, via Nagpur, of the South Eastern Railway.

The tungsten-bearing minerals occur in the quartz veins or reefs in the phyllitic and quartzitic country rocks belonging to the Archaean metamorphics, the characteristic geological formations of North Bankura and North-West Midnapore Districts of West Bengal. The thickness of the quartz veins varies between 4 to 6 ft.

Tungsten minerals are intimately intermixed with quartz but though the mineralization seems to be sporadic there are several areas where a rich concentration of ore-minerals can be noticed, but these occurrences are rare. Sufficient quantity of ore can be recovered from the eluvial deposits accumulated at the foot of the reefs.

Several samples were collected and polished sections were prepared. When examined under a mineral light lamp, emitting ultra-violet light, two different minerals were detected. Bright fluorescence was observed from the irregular linear cracks filled with Scheelite (CaWO_4); the Wolframite ($\text{Fe, Mn} \text{ WO}_4$), which forms the main bulk of the ore-minerals, does not show any appreciable fluorescence.

Under the ore-microscope, Wolframite shows a replacement texture, having been replaced by Scheelite almost in every part of the specimens examined. Along with Scheelite, there are high-reflecting iron-bearing minerals—magnetite—martite, which shows zoning and altered appearance. These minerals are found only in the Scheelite bands replacing Wolframite. Reflecting powers of all these ore-minerals were determined by a Berek-Slit-Photometer using green filter.

The following readings were obtained :—

(1) Wolframite—17. (2) Scheelite—13.2. (3) Martite—23.

The microscopic examination of these ore-minerals has revealed that the mineralization seems to be perometasomatic type of Lindgreen. Wolframite being the principal tungsten-bearing mineral formed first near the contact metamorphic zone along with the invaded rock. Scheelite and iron-bearing minerals were formed

afterwards, replacing the Wolframite as linear bands and sometimes in isolated patches.

(iv) Petrology.

32. The Ultrabasic Rocks of Kudada, Singhbhum district.

DIPAKKUMAR RAY, Calcutta.

Numerous petrological variations have been observed in the metamorphosed ultrabasic rocks of the Iron Ore Stage, occurring in the Dhoka Hills ($86^{\circ} 12' 30''$ E; $22^{\circ} 42' 30''$ N). The variations are from massive Tremolite-Actinolite-Chlorite rocks to Actinolite-tremolite schists with replacement quartzites and quartz-microcline veins.

Important mineralogical transformations are the evolution of the Antigorite-Penninites from the Olivines, and through intermediate amphiboles from the Pyroxenes and Talc-Limonite from the green Chlorites.

Pseudomorphous replacements, poikilitic relicts, general absence of schistosity, presence of cataclastic textures and puckered schistosity in a few spots and a schistosity in ferro-magnesian minerals in the replacement quartzites are the chief textural and structural features.

The ultrabasic rocks were slowly injected along thrust planes of the Singhbhum Thrust. The subsequent regional metamorphism transformed them into a green schist facies assemblage. The necessary aqueous solutions were due to compaction and compression of the pelitic sediments of the Iron Ore series. The effects of the late- and post-kinematic granitic emanations are manifest only in the sporadic phlogopitisation and silicification of the already metamorphosed ultrabasics. These events are important links in the history of the geosyncline that gave birth to the Iron Ore series.

33. A Petrological Note on the Metamorphites around Sonapahar in Khasi Hills, Assam.

ANIL KRISHNA BANERJEE, Gauhati.

The sillimanite-corundum bearing rocks have earlier been reported from the Nongstoin State of Khasi Hills, Assam. The analysis of the trend of petrological evolution of the associated metamorphites and their relationship with the granite-gneiss of the area, hitherto lacking any serious consideration, constitute the chief theme of this paper. The associated cordierite-biotite-sillimanite gneiss, quartz-sillimanite schist and sillimanite-corundum rocks are regarded as compositional variants of the same aluminous sedimentary formation. Associated with this group there also occur several bands of epidioritic rocks. Both these two groups of rocks bear clear impression of having suffered polymetamorphism. Their mineral paragenesis shows a transition from granulite facies to cordierite-anthophyllite subfacies of the amphibolite facies. This regressive character has been related with the regional granitisation of the area. Concentration of bunches of topaz, nodules of pyrite, rutile, tourmaline etc., in the sillimanite deposits, gradual acidification of plagioclase and ingress of quartz and microcline in metamorphites towards the contact with granite-gneiss are indications of granitic influx. The ptygmatic folding of granite-gneiss and pegmatite veins suggest strong plastic deformation. Sillimanite veins in corundum are thought to be recrystallised products along local planes of shear or fracture under metasomatic process.

34. On the Soda-granite, South-East of Tatanagar, Singhbhum District, Bihar.

A. K. BANERJI, Calcutta.

The soda-granite lying south-east of Tatanagar ($22^{\circ} 42' - 22^{\circ} 44' \text{ N} : 86^{\circ} 11' - 86^{\circ} 15' \text{ E}$) has been studied. From mineralogical, textural and structural considerations the following sequence of events appear to have resulted in the evolution of the soda-granite :—

- (a) The geosynclinal sediments in this region were folded due to tectonic compression directed from the north to the south. The rocks became 'soft' and recrystallised completely giving rise to schistosity and a prominent a-mineral lineation accompanied by minor puckers and crenulations in both "a" and "b" directions essentially due to closely spaced inter-planar slipping. At the close of this episode the rocks started to become rigid.
- (b) Sometime later, when movements almost ceased, a 'front' of Na-Si metasomatism was employed in the region now occupied by the soda-granite. That the soda-granite has evolved by the replacement of pre-existing schists is indicated by the relics of schistosity in it, the development of pseudo-cataclastic, myrmekitic and micrographic textures, and other changes in mineralogical composition etc. Concomitantly with the above event a 'front' of K-Fe-Mg-Al appears to have moved ahead giving rise to garnet, staurolite, kyanite bearing oligoclase-muscovite-biotite schists to the north and albite-sericite-chlorite phyllites to the south of the soda granite according to the prevailing metamorphic conditions in the two regions during metasomatism. The lineations described under (a) above were disturbed in the soda-granite during metasomatism.
- (c) Much later the rocks became more or less 'rigid' and moved as plates giving rise to striation lineation on certain planes. The soda-granite, the schists, and the phyllites were equally affected.

It has not been possible to be certain about the source or cause of emplacement of the Na-Si metasomatic front at this stage of the investigation but the suggestion that the soda-granite may be the graphic end of a normal granite may be ruled out. Further investigations will, it is hoped, throw more light on the exact relationships between metamorphic and metasomatic episodes on the one hand and tectonic events on the other in this region.

35. The modal composition of a granite pluton in north-western Bhandara, M.P.

V. VENKATESH, Calcutta.

A small pluton of muscovite-biotite granite, measuring two miles in diameter and emplaced within the Sausar rocks, has been studied in some detail. Twenty-four specimens were collected and 34 modal analyses were made on stained thin sections. The grain size of the rock ranges between 0.5 and 2.0 mm. A minimum area of 400 mm² was covered per section at 0.5 mm. intervals, using the point counting technique.

The specimens have a homogeneous appearance but there is great variation in the modes obtained from the two halves of the same thin section (maximum difference of 18% of the mineral for the major constituents), as well as in modes obtained from two thin sections cut from the same specimen (maximum difference of 30%). Hence, these modes are inadequate for the purpose of showing any systematic variations in mineral composition within the pluton. However, the mean of the 34 modes given below, together with the range, represents an average

composition of the granite : quartz : 31.4 (23.8-38.3), potash feldspar : 33.0 (26.1-49.6), plagioclase : 27.6 (16.7-35.8), muscovite : 5.5 (0-10.6), biotite : 2.5 (0.9-8).

It is concluded that several modal analyses are necessary for petrological interpretation, especially in coarse grained rocks where single modes are not sufficiently representative. Data regarding the area covered in thin section, number of thin sections used, traverse interval and grain size of rocks are important and should accompany a mode.

36. Olivine metadolerites of hortonolite ferrogabbro composition from Dubhi Tahsil, Mirzapur District, U.P. and Palamau District, Bihar.

M. V. N. MURTHY, Calcutta.

Iron-rich olivine metadolerites occurring as sheets interbanded within the crystalline complex in Dudhi tahsil, Mirzapur district, U.P. and the adjoining Palamau district, Bihar have olivines of the hortonolite group ($\text{Fa}_{38}\text{-}\text{Fa}_{66}$) and are therefore classifiable as hortonolite ferrogabbros, described originally from Skaergaard, Greenland, by Wager and Deer according to whom, ferrogabbros must contain olivines with more than fifty molecular percentage of fayalite. Petrological studies suggest that the metamorphism of the dolerites has not seriously altered their composition and hence the comparison is justified. In Skaergaard, the ferrogabbros are produced by 'strong fractionation' after the emplacement of the normal basic magma. The rocks studied by the writer are, however, hypabyssal sheets which suggests that magma of ferrogabbroic composition can be produced even at depth.

37. Petrological and Thermal Studies of some Bauxite samples from Mewasa, Bombay State.

SYAMADAS BANERJEE, Calcutta.

Physical, chemical and microscopical studies of some bauxite samples from Mewasa, Jamnagar, Bombay State, reveal the predominant presence of gibbsite. Other minor mineral constituents are kaolinite, rutile, ilmenite, magnetite, haematite and limonite. Gibbsite (av. $\text{RI}=1.579$, $\text{Z}\backslash\text{C}=22^\circ$; low biref: elongation +) is present as fine laths and plates or as cryptocrystalline aggregates forming mostly the cores of the pisolites, fringed by brown and reddish ferruginous clayey matter. Greyish white and reddish earthy materials form the matrix. In one sample considerable amount (normative proportion 22.23%) of calcite is present as veins and replacement patches. Differential thermal analyses of these samples show endothermic peaks at 320°C , 340°C and 800°C respectively, indicating the presence of gibbsite for the first two and carbonates for the last one. All these bauxite samples are low in titania content ($<2.40\%$) and some are rich in alumina (7.60%) and low in silica (1% and less) and iron ($<2.40\%$). These may be suitable for aluminium manufacturing and refractory purposes.

38. On the Precision of Modal analysis of Rocks.

AJIT KUMAR SAHA, Calcutta.

Modes of three large thin sections cut at random from a single specimen of dolerite dyke from Kakrapar, Gujarat, were determined by the point-count method as well as by Dollars' integrating stage. One of the sections was analysed eight times each and the other two twice each by both the methods. Using the techni-

ques of variance analysis and *t*-tests, it has been found that the random errors for the two methods are essentially the same and that there is no significant bias between the two methods. One of the thin sections showed significant differences from the other two, as regards properties of most of the constituents, although, on an average, the variations between the thin sections are not significant for any constituent. It is suggested therefore that for accurate modal analysis of even an apparently 'homogeneous' rock, at least three or four thin sections should be analysed. For rocks with visible dimensional orientation, coarse grain-size or with banded structure, a large number of sections should be analysed.

39. Petrology of the Archaeans around Muri, Ranchi District, Bihar.

NIRANJAN DEB CHATTERJEE, Calcutta.

An interesting assemblage of Archaean metamorphics and granites around Muri, Ranchi dist., Bihar, has been studied in some detail over an area of 55 sq. miles. The area is represented in the Survey of India Topo Sheet No. 73E/15 and is bounded by 23° 20' N to 23° 28' N latitudes and 85° 47' 30" E to 85° 52' E longitudes. Excepting for a small part of it, the area was so far unmapped.

The rock types include highly metamorphosed calc-silicates, now represented by diopside and tremolite bearing gneisses (always devoid of free calcite), peli-psammitic schists now represented by micaceous quartz-schists with rare sillimanite-kyanite bearing types; while the basic assemblages include bands and dyke-form bodies of amphibolites and hornblende-schists which are believed to be of igneous parentage. A thin band of granite-gneiss showing perfect structural homogeneity with the metamorphics occur to the north. This has been traversed by a series of east-west trending highly dipping reverse-faults.

An imposing width of Porphyritic Granite has also been studied. It shows primary flow-structures. The foliation and lineation in this granite are not in harmony with those in the metamorphics.

The metamorphics show folding of foliation planes to compressed high dipping isoclines pitching low to the east and these folds have a distinct tendency to open out into doubly pitching anticlines and synclines to the north. The Porphyritic granite has intruded this superstructure late to post-kinematically more or less following the structural planes in the metamorphics.

The metamorphics can be referred to the Staurolite-Kyanite and Sillimanite-Muscovite sub-facies of the Amphibolite facies. In the zone of dislocation, local phyllonitisation of the sillimanite-schist with concomitant diaphoresis has been noted. Among other effects of this dislocations are local development of a lineation and *bc* girdle with relict small-circle incomplete *ac* girdle in the quartz-fabric respectively set against regionally developed *b* lineation and *ac* girdle

40. A note on the Quartz bearing Anorthositic Rocks of Dublabera, District Singhbhum, Bihar.

T. C. BAGCHI, Kharagpur.

This paper deals in brief with the petrology and genesis of quartz-anorthosite of Dublabera in Singhbhum Dist., Bihar. The anorthosite occurs as patches in the gabbro often grading imperceptibly into it. The rock contains two types of feldspar, an earlier sassuritised plagioclase ($Ab_{50}An_{50}$ to $Ab_{70}An_{30}$) and a later albite. The pyroxenes include hypersthene of the lamellar type. Quartz is invariably present and interstitial. Often concentration of feromagnesian minerals at places has given rise to mottled anorthosite.

It is shown that during differentiation of gabbroidal magma separation of the early formed fraction resulted in the formation of anorthosite. Crystals of pyroxene settled in this magma and have given rise to mottled anorthosite. Late stage hydrothermal solution has formed the albite. It is likely that some quartz has been due to assimilation of quartz rich sediments by the magma but a part of it is later and perhaps deuteric.

41. On a Lamprophyre Dyke in the Granitic Complex near Gumla, Ranchi District, Bihar.

TUHIN KUMAR DUTTA, Kharagpur.

The paper records the occurrence of an isolated dyke-like lamprophyric rock in the granite-gneisses near Gumla ($23^{\circ} 2' 30'' : 84^{\circ} 32' 40''$). The outcrop trends N 85° E with a width varying from 10 to 15 feet. The dyke is a dense, melanocratic, fine-grained lamprophyre rock which has been cut across by quartzo-felspathic veins. It has been granitized at places imparting a coarse-grained texture at the contact.

Microscopic examination reveals that the rock is one of hypidiomorphic and porphyritic texture and that it falls within the group of dioritic lamprophyres. It is essentially a biotite-augite-hornblende rock containing both plagioclase and orthoclase, with phenocrysts of augite and plagioclase feldspar (oligoclase) in a groundmass of feldspar and biotite with quartz, apatite and iron ore as accessories. Thus the rock may preferably be named as Augite-kersantite.

The sequence of crystallization, as inferred from thin section study of the rock, indicates that the ore was the first member to crystallize out, followed by pyroxene, biotite, apatite, feldspar, and last of all, quartz. This sequence differs from that of Johannsen (1937) in the fact that the apatite occurring in this dyke rock crystallized later than pyroxene.

During regional metamorphism and metasomatism feldspathization of the lamprophyre has taken place which is evident from abundance of biotite along the lamprophyre-granite-contact zone and gradual increase of feldspar in the granitized part of the lamprophyre. Bigger and prominent crystals of biotite at the contact developed due to recrystallization, which was perhaps aided by the presence of alkaline solution during metasomatism.

42. A preliminary note on the petrography of Quartz-porphyry and related rocks near Nabinagar, Gaya district, Bihar.

R. C. MISHRA, Patna.

The paper deals with microscopic investigations of the rock collected from the area. The rock was first reported by Medlicott in 1863-64 named as Trappoid and later on named as Porphyritic Rhyolite by E. Vredenburg. The microscopic studies made by the author reveal that they are quartz porphyry rocks with characteristic porphyritic texture with large phenocrysts of quartz and feldspar set in fine grained matrix consisting partly of quartz and feldspar and partly of microcrystalline mass. Its relation in the field with porcellanite of the Semri series as noted by the author is of intrusive nature in sill like form. Microscopically the porcellanites possess the same minerals as possessed by quartz porphyry rocks but they differ only in grain size.

43. Textural peculiarities of the Arkasani Granophyre.

P. P. AGRAWAL, Patna.

In this paper the author has studied the textural variation of Arkasani Granophyric masses, around Kharsawan village in the Singbhum district. A wide variation

of the implication textures—cuneiform, myrmekitic, irregular, radiating-fringe and feathery types to wholly metamorphic poikiloblastic and glomeroporphyritic textures of the Arkasani masses are not due to eutectic crystallisation but they are as a result of secondary processes. The implication texture is due to granulation and recrystallisation of the pre-existing quartz and alkali feldspars aided by metasomatic development of the albite porphyroblasts in the solid rock. The albite porphyroblasts in the solid rock have grown metasomatically at the same time while the stress was in progress.

44. Petrography of the Basic Rocks of the Auranga—Koel Valley, Palamau, Bihar.

RAGHUJI VERMA, Ranchi.

The occurrence of a large area of basic rock in the Auranga-Koel Valley in the district of Palamau, has been reported by Rode and the present author (1947). Detailed microscopic study of these rocks has revealed a wide variation in mineral composition. The primary constituents of these rocks are plagioclase, pyroxenes, amphiboles and olivine. Among the ferro-magnesian minerals, olivine, pyroxene and hornblende show interesting structures. In some of the sections olivine shows marked reaction rims. The inner rim, the one immediately surrounding the olivine is generally a colourless mineral with high birefringence—a pyroxene. The outer rim composed of a fibrous material with greenish colour is pleochroic—hornblende. The following types of basic rocks have been recognised by the author in this area bounded by longitudes 84°0' and 84°15' E and latitudes 23°50' and 24°5' N (Topo sheet 73 A/1) :—

1. Hornblende Gabbro.
2. Hornblende Norite.
3. Hornblende-Biotite Norite.
4. Hornblende-Garnet Gabbro.
5. Hornblende-Olivine-Hypersthene Gabbro.

45. A Note on the Petrography of the Lamprophyres from near Sadariadih, Jharia Coalfield.

D. LAHIRI, Calcutta.

Specimens of lamprophyre dykes and sills were collected from near the village Sadariadih (Long. 86° 11' 40" : Lat. 23° 45' 45") in Jharia Coalfield. The rocks are very much weathered, looking like sandstone in hand specimens. These are very tough, reddish brown to dark grey in colour, sometimes amygdaloidal with cavities filled up with carbonates, flakes of lustrous bronze coloured biotites are embedded in the saccharoidal groundmass. The rocks have an average specific gravity of 2.7.

Microscopically, the rocks show porphyritic texture having phenocrysts of altered olivine, corroded and chloritized biotite in a fine grained groundmass consisting of altered feldspar laths and euhedral microphenocrysts of leucite. Usual accessories like apatite, granules of euhedral ilmenite and rutile are dominant. Important secondary minerals include dolomite (as determined on the Universal stage), interstitial quartz, and patches of chlorite.

As the feldspar cannot be definitely identified due to alteration, the rocks can be best named biotite-lamprophyres.

46. Petrology of the sedimentary metamorphites around Kushtanr, Manbhum District, Bihar.

AMALENDU ROY BARMAN, Calcutta.

The area lying between 23°20'—23°26'30" and 86°24'30"—86°32' in the district of Manbhum, Bihar, is an Archaean terrain composed of sedimentary metamorphites,

composite gneisses, granodiorites, aplo-granites, granite-gneisses and porphyritic granites.

The sedimentary metamorphites comprise (1) Sillimanite gneisses and psammitic schists, the common assemblage being sillimanite-almandine-biotite (muscovite)-quartz-potash feldspar-plagioclase, with epidote, graphite, chlorite, apatite etc. as accessories and (2) calc-silicates and associated para-amphibolites consisting of diopside ($N_m=1.686$ $Z\wedge C$ 36°) gradually varying to hedenbergite ($N_m=1.718$, $Z\wedge C$ 47°), garnet, plagioclase (andesine to labradorite) hornblende, quartz and phlogopite with minor amount of sphene, graphite, epidote-zoisite etc.

The imperceptible passage of the calc-silicates to the amphibolites gives an unequivocal evidence of the sedimentary origin of the amphibolites. The granite-gneisses are structurally conformable with the sedimentary metamorphites and exhibit intimate association with them.

Towards granite, the calc-silicate rocks show gradual variation in the percentages of quartz and potash feldspar with simultaneous acidification of the plagioclases (An_{54} - An_{45}). The psammo-pelitic rocks are, similarly, impoverished of sillimanite concomitant with the increase in the proportion of microcline, biotite, muscovite and quartz in the vicinity of the granite. The above changes can be traced along with the exposures in all the three dimensions.

47. Petrochemistry of the Rajmahal Traps, Santhal Parganas, Bihar.

SUBHENDUKUMAR BAKSI, Calcutta.

Chemical analyses of three specimens from the lower, middle and upper portions of a particular flow in Dharampur area ($24^\circ 47'N : 87^\circ 32' 44'' E$) show the following average composition :— SiO_2 —50.03%, Al_2O_3 —14.10%, Fe_2O_3 —3.08%, FeO —9.24%, MgO —5.79%, CaO —9.55%, Na_2O —2.88%, K_2O —1.01%, H_2O (\pm)—2.33%, TiO_2 —1.99%. All the three analyses indicate that the rocks can be safely relegated to Washington's Plateau basalts, particularly on the basis of high ferrous-iron content, together with other characters. These compare well with the analyses of the Deccan traps, and with those of the basalts from Oregon, New Jersey and Patagonia. In the flow, norm composition varies slightly from the base upwards. Olivine is absent in all the norms. Quartz is present in the norms but is absent in the modes. A correlation with the glass content of the specimens analysed shows that normative quartz is higher in the glassy varieties, i.e. in the lower and the upper part of the flow. This association perhaps suggests that silica was concentrated in the residual liquids now represented by glass. The normative minerals in the rock from the lower part of the flow show marked differences in amount from the other two rocks, and this is perhaps due to the presence of microlites and uncrystallized components in the glass.

48. Anorthosites, Khondalites and Granitoid gneisses of Kalahandi District, Orissa.

S. C. CHATTERJEE, Patna.

An occurrence of anorthosite near Turkel in the former Kalahandi State was recorded by Dr. T. L. Walker in 1902. No further work was done on this area since then. The author has recently studied the area and has made an extensive collection of different varieties of the anorthosite and the associated khondalites and granitoid gneiss which are characterized by large feldspar porphyroblasts. The khondalites have been feldspathized in this area and show the presence of rhombic pyroxene as in the gneiss which indicate that the granitoid gneisses have been formed by a more intense granitization and feldspathization. The different varieties of the anorthosites have been described with the optical data of their constituents.

49. Fibrolite (Sillimanite) in the migmatites of Tilatanr near Tetulmari (E. Ry.), Jharia Coalfield, Bihar.

M. S. SADASHIVAIAH, Dhanbad.

The metamorphic terrain around the Jharia Coalfield, of which Tilatanr area is a part, is composed of the metamorphic rocks of Dharwar age, which during the post-Dharwar times were subjected to an injection metamorphism. The Dharwar metamorphic rocks of the injection complex show different degrees of metamorphism. One important feature shown by the pelitic and semi-pelitic rocks occurring in the migmatitic complex round about Tilatanr village is the presence of fibrolite (sillimanite). Fibrolite occurs not only in the pelitic and semi-pelitic rocks but also in the numerous leucocratic veins which traverse these rocks. Fibrolite occurs in the pelitic and semi-pelitic rocks, as needles, tufts, mats, knots and faserkiesel or quartz-sillimanites. The field and petrological evidence shows that the mineral fibrolite has no bearing with the conditions of regional metamorphism but it was formed as a result of metasomatic activity (alumina metasomatism) after the feldspathisation of the host rocks of the injection complex, when the energy level of the injection metamorphism was on the decline. Its formation was aided by the pegmatitic solutions rich in alumina, silica and boron which traversed the host rocks. Therefore, in the Tilatanr area the fibrolite is not an indicator of the grade of metamorphism. Evidences are given in the paper in favour of the above conclusion.

50. Basic intrusions around Ankola and Gokarn area, District North Kanara, Bombay State.

R. V. JOSHI and Y. V. DESHPANDE, Dharwar.

A large number of basic dykes traverse the granite-gneiss of this area. They have varying trends but approximately fall in three groups, viz., dykes having strikes: (a) 55° - 70° (12); (b) 110° - 120° (7); and (c) 170° - 185° (5). In almost all the dykes, pyroxene has been partly or wholly altered into fibrous or compact amphibole. Two of them show distinct foliation. Texturally the rocks appear to be gabbroid or medium grained dolerites (meta-gabbros, meta-dolerites). Only in four dykes which are fine grained, pyroxene does not show any alteration.

51. A Note on the origin of Magnetite Deposits of Gore Pahar in Palamau District, Bihar.

S. N. WAKHALOO, Patna.

During the course of a reconnaissance survey of the country in and around Daltonganj in Palamau District, magnetite ore occurrences which crop out at the Gore Pahar were carefully studied with a view to arriving at an idea about their origin. In that hillock Pre-Cambrian tremolite schists are intruded by a dolerite dyke which has possibly brought about their mineralisation and enriched them with magnetite. The tremolite schists are highly lineated and the magnetite, which is intercalated along their weak planes, gives them a dark appearance. A thorough petrographic study of the dolerite and tremolite schists has been made and further investigations are in progress. Sample of dolerite which has been analysed chemically indicates high percentage of iron. The occurrence of this element in unusually considerable quantity is very significant, and since there is no other source known in the area from which the magnetite could be derived, the facts warrant the belief that magnetite deposit was produced by the hydro-

thermal solutions emanating from the residual basic magma which gave rise to dolerite intrusion. The ore has possibly originated contemporaneously with the alteration of the original sediments of dolomitic composition. The path of the ore solutions have been controlled by the lineation and jointing in the tremolite schists.

52. The Gneissic Rocks around Gorabari, Bankura District.

PRASENJIT SAHA, Calcutta.

An area of approximately ten square miles of gneissic rocks just north of the village Gorabari, Bankura Dist. has been studied in detail by the author. These rocks belong to the Chotanagpur granite gneiss. From petrological, mineralogical and chemical studies of these rocks, discussed in this paper, the author concludes that these rocks are not strictly magmatic in origin, and moreover, more than one phase of intrusion of granitic and hydrothermal liquids into the pelitic schists is indicated. Studies on the sequence of mineral formation, perthites, myrmekites, micrographic intergrowths, etc., help to establish the sequence of the different phases of intrusion. Some suggestions have been put forward to explain the different phases of intrusion. The conclusions are only tentative, since intensive work on the structure of the gneissic rock is needed, which the author intends to carry out in future.

53. On the Rhyolitic Conglomerates of East Bhandara, Madhya Pradesh.

S. N. SARKAR, Kharagpur.

The rocks interpreted as "recrushed and conglomerated mylonites" by the previous worker have been proved by the present author to be undoubted rhyolitic conglomerates of sedimentary origin, consisting of boulders, cobbles and pebbles of variously coloured rhyolites ($<90\%$), trachites, andesites, with minor amounts of granites, granophyres, granite-gneisses, vein quartz, quartzites, siltstones, cherts etc., in a finer grained heterogenous matrix. Generally the degree of roundness of pebbles etc., is good to fair with local increase in angularity. The larger cobbles are usually better rounded than the smaller ones and finer matrix material. The sorting is commonly poor with high range of sizes, e.g., from a fraction of an inch to 3 feet across; and the mean size in general is less than one-tenth of the maximum size. The pebbles and cobbles of rhyolites with planar and/or swirling flow layers occur rather haphazardly with those of the massive rhyolites and other rock types. The ratio of the porphyritic to non-porphyritic rhyolites among the pebbles and boulders varies from place to place, but regionally those of the porphyritic type predominate on the west and of the non-porphyritic type on the east and north-east. These conglomerates unconformably overlie the porphyritic rhyolites, and occur as closely folded synclinal outliers in the latter. By comparing the flow layers and sedimentary bedding, the younger rhyolitic flows are found to be nearly conformable to the underlying Rhyolitic Conglomerates.

54. The Hypabyssal Diorites and Diorite Porphyries of East Bhandara and Western Drug, Madhya Pradesh.

S. N. SARKAR and BARUN SENGUPTA, Kharagpur.

The rocks previously recorded as "greenstones" have been found to be dioritic intrusives consisting mainly of andesine, augite and their alteration products with ophitic to intergranular texture. The diorite porphyries have phenocrysts of

plagioclase in a much finer grained matrix. These dykes and sills exhibit marginal chilling with coarser central parts, whereas the narrower ones may be chilled throughout due to rapid cooling. The average grain size usually increases with the increasing thickness of the body. All intermediate stages are recognisable between the coarse dioritic rocks on the one end and the aphanatic andesites on the other; and from the field relations, mineral composition and texture, the dioritic rocks appear to be undoubted hypabyssal equivalents of the associated andesites. Occasionally in the lower parts of certain sills there are impersistent layers of coarse pyroxenite or peridotite which grade upwards into coarse diorite by the increase of plagioclase and corresponding decrease of mafic minerals, and are probably formed by gravitative crystal settling in a slowly cooling magma. The amygdales, when present, are usually concentrated towards the upper parts of the sills.

Mainly two groups of dioritic rocks have been recognised. One group, including most of the diorite porphyries, may be correlated with the Lower Andesite formation which is later than the rhyolites and older than the granites, and the other group with the younger Middle and Upper Andesite formations. Interesting field and microscopical features are discussed.

54A. Dyke Rocks in Portuguese Goa.

K. V. KELKAR and P. D. DHEPE, Poona.

Of 22 dyke rocks that the authors came across in Goa (Lats. $14^{\circ} 53'$ — $15^{\circ} 44'$, Longs. $73^{\circ} 45'$ — $74^{\circ} 26'$) seventeen were found to be Newer Dolerites and five Deccan trap dolerites.

Of the Newer Dolerites six are dolerites with labradorite, monoclinic pyroxene and quartz usually in the form of micropegmatite; eight are olivine and olivine-hypersthene-gabbros. One is a dyke basalt. The monoclinic pyroxene in all these rocks has a moderate axial angle ($+2V=30^{\circ}$ to 48° and subordinate amounts of grains with $+2V$ less than 30°) and the plane of optic axes is the plane of symmetry. The pyroxene in all the rocks has been more or less uralitised with the production of secondary hornblende and traces of biotite, both of which contain a few minute inclusions surrounded by feeble pleochroic haloes (radius nearly 0.02825 mm. in hornblende; 0.03375 mm. in biotite); rocks of two of the dykes have been converted into epidiorites.

The Deccan trap dolerites consist of small phenocrysts of labradorite set in a groundmass of labradorite, monoclinic pyroxene of usual variety, titaniferous iron ore, small amounts of glass (usually changed to brown or green palagonite) and a few grains of olivine. Fresh olivine is rarely found, the mineral being usually represented by pseudomorphs consisting of palagonite, delessite or iddingsite.

(v) Economic Geology.

55. On the source of the Panna Diamonds and the Nature of the Majhgawan Plug.

F. AHMAD, Calcutta.

Panna Diamond Mines have attracted considerable attention in recent years and the opinion, nearly unanimously, favours a volcanic origin for the Majhgawan plug. This paper describes this plug in some detail and discusses the theories of its origin.

The author draws attention to several features which are incompatible with the current hypothesis that it is a 'plug', 'neck' or 'pipe'. Thus, he points out that the presence of uniformly small size of inclusions in the agglomerate is diffi-

cult to explain. The hypothesis that the inclusions were picked up by the rising lava does not seem to explain several of the features observed by the field geologists in the exposure. The author also compares Majhgawan with similar occurrences in Africa and finds that they differ materially, nor is there any similarity with any part of a typical extinct volcano.

Sinor's explanation, it is pointed out, is, in certain respects, self contradictory. The origin and source of diamonds, the occasionally fresh conditions of the olivine crystals, the presence of 'shaly band' in the core, the absence of contemporaneous lava or distinct erosion surface on the horizon all go against the generally held hypothesis. The absence of granite inclusions in the plug or of 'kimberlite' inclusions in the sedimentary conglomerate is considered to be inexplicable. Mathur's suggestion of repeated volcanic activity only multiplies the difficulty of explaining the absence of extrusive lavas, and is inadmissible on other counts. The possibility of the existence of other similar plugs, now concealed, is discussed and it is pointed out there is practically no area where they could exist. Khedkar and Deshpande's opinion that it is an ultra-basic intrusive rock has no basis and no evidence to support it. It is, moreover, pointed out that the diamonds in the conglomerates bear all the impress of deep seated origin, and this significant piece of evidence has, unfortunately, not been taken into account by previous authors.

The present writer, therefore, considers that what has been described as a basic rock could be greywacke. The drainage at the time was from the north and the west and the diamonds, as had been pointed out by Vredenburg, had their source in that region. A glacial agency is, very diffidently, invoked to explain the observed features.

In conclusion, the author asks for more detailed work and drilling in the area.

56. On the occurrence of chromite near Pauni, Bhandara District.

M. G. PAITHANKAR, Jabalpure.

During the systematic geological investigation of the area around Pauni ($20^{\circ} 47' : 79^{\circ} 38'$), Bhandara district, an occurrence of chromite about six furlongs N.W. of the town has been located. This is the first recorded occurrence of chromite in Madhya Pradesh.

The area is mainly occupied by the Archaean rocks belonging to the Sakoli series. The rock formations found in the area are muscovite-chlorite-gneiss, quartzites, phyllites, hornblende-schist, chromite, talc-schist, talc-chlorite-schist, chlorite-albite-zoisite-schist, tremolite-chlorite-schist and pegmatite. General strike is E.N.E.-W.S.W. to E.-W. with high dips towards N.N.W. to north. The talc-chlorite-schist and allied rocks show an intimate relationship in the field with hornblende-schist, all of which seem to represent metamorphosed ultrabasic and basic igneous rocks intruded into the Sakoli series. The outcrops of chromite are seen in patches for about a mile. The ore occurs massively, and is traversed by small veins of talc but in places float ore is also found.

In thin section the ore is found to be highly fractured and the cracks are occupied by veins of talc and chlorite. A few grains with pyroxenic form and cleavage are also seen. The talc-schist and allied rocks also reveal under the microscope the presence of a few mineral grains with pyroxenic cleavage and outline.

57. Occurrence of Tin and Tungsten around Chakrabanda, Gaya District, Bihar.

S. N. P. SRIVASTAVA, Calcutta.

The paper deals with the geology of the area around Chakrabanda ($24^{\circ} 30' : 84^{\circ} 28'$) in the Gaya District, Bihar, the nature of the tin and tungsten deposits encountered in the area, their origin and economic possibilities. The deposits are

located in an area about $2\frac{1}{2}$ miles long and 400 yards wide. The main rock types in the tin and tungsten area are the sillimanite-sericite-quartz-biotite-schist and not granite-gneisses as reported earlier. Tin occurs in form of cassiterite in garnet- and garnet-tourmaline veins, mainly located in the southern part of the area, whereas wolfram is particularly noted in the northern part. Rarely cassiterite is found in the acid veins, and in sericite-schist. Wolfram and scheelite are occasionally found associated with cassiterite. The mineralisation is linked to the pneumatolytic phases of a granitic intrusion. The SnO_2 content of bulk samples of the ore varies from 0.20 to 0.21%. Large scale mapping and detailed prospecting are recommended. The ore should be amenable to beneficiation by simple ore dressing methods.

(vi) Sedimentology.

58. On certain Intercalations of Marine Probable sourcerocks for oil with sub-Himalayan Gondwanas.

B. LASKAR, Calcutta.

Recent geological surveys by the author in portions of the sub-Himalayan Gondwana belt in Dikrong valley and further east (between longitudes $93^\circ 50'$ and $95^\circ 20'$) reveal presence of several marine intercalations of considerable thickness in the usual continental type of Gondwana sediments.

One of these upper bands in the Dikrong valley has yielded *Conularia laskeri* sp. nov. (determined by Sahni and Srivastava, *Curr. Sci.* 24, No. 6, p. 187, 1955), ascribing a Permo-Carboniferous age to these beds.

Some of the beds in the lower parts of the sequence in the Ranga valley reveal intercalations of graywacke, tuff, trap flows and agglomerates correlated to the Abor Volcanics. These volcanics and the associated Gondwana rocks are traversed by younger intrusives.

The usual lacustrine and fluvial environments of the Damudas (Lower Gondwana) have given rise to a complex of predominantly near-shore humid and lagoonal environment. These features are borne out here by the frequent association of continental type of sediments with several beds of occasionally fossiliferous, laminated, pyriteous slates, dark to gray in colour due to organic contents.

Syngenetic with these slates are numerous dark cherty and dense impure calcareous nodules and concretions some of which yield finely preserved marine forms, viz., *Chonetes* sp., *Spirifer* sp., *Productus* sp., marine gasteropods, and crinoid remains. Rarely, flattened, discoid phosphatic nodules with high surface-lustre occur in these slates. The organic matter in these dark slates is in a fine state of comminution.

The paucity of good coal seams here appears to be due to changes in environment of deposition. However, there is a growing recognition that oil is a common, and not unusual product of near-shore marine and restricted-basin sediments. Southwards from this highly disturbed belt in the sub-Himalayas these Gondwana beds are likely to continue, (under a heavy cover of Tertiary and younger deposits), into the plains at the upper reaches of the Brahmaputra Valley and may prove good source-rocks for oil there.

59. A Note on certain dune sands from the Kaliana area, Mahendragarh District, PEPSU.

A. B. BISWAS, Calcutta.

This note presents the results of size grade and heavy mineral study of certain samples of dune sand from the Kaliana area ($28^\circ 33' : 76^\circ 12'$, 53 D) of the

Mahendragarh district, PEPSU. The dunes occurring in the area are of two types; one type consists of bare piles of loose sands which are unstable in position and capable of migration from place to place under the influence of the prevailing wind, the other type is more or less fixed and stabilized by growth of semi-desert vegetation and occurs as ridge like bodies aligned more or less east-west. These aeolian sands are of regular nature, characterized by a uniform grain size and mechanical composition. They are very highly sorted and well rounded having a coefficient of sorting (S_0) below 2.0 and appear to have been deposited under uniform conditions of wind. The sands are composed mainly of quartz and feldspar, but the results of heavy mineral analysis show an interesting assemblage consisting of magnetite, ilmenite, garnet, amphiboles, pyroxenes, epidote, zoisite, micas, tourmaline, sillimanite, kyanite, monazite, and zircon.

60. Studies in the heavy minerals of the Lameta and Jabalpur beds at Lametaghat, Jabalpur District, M.P.

G. W. CHIPLONKAR, K. N. DAS and K. N. MURTY, Sauger.

The microscopical and statistical studies of the heavy mineral assemblages of the Jabalpur and the Lameta beds at Lametaghat have been carried out to investigate the effects of sorting, degree of interstratal leaching, probable sources of the detritus, origin, and depositional and transportational history of the material of these two series. The results of these studies have been graphically represented and interpreted. They show :

1. that both the series are fresh water, irregularly laid sedimentaries deposited under comparatively shallow water conditions;
2. the conditions prevailing during their deposition were similar and that they have parallel history of sedimentation with a slight transgressional unconformity between the two series;
3. the provenance for these two series was the same, and comprised granite-gneisses, schists, basic dykes, pegmatites and quartz reefs evidently of Dharwarian facies and occurring not very far from the place of deposition;
4. the calcareous material of the Lametas is from the calcareous members of the surrounding country;
5. the Lametas had their detritus from wider range of rocks than the Jabalpurs and the former have made the latter their source for some part of their detritus;
6. the topography of the terrain during their deposition appears to have been gentle and the physiographic conditions prevailing during the deposition of individual beds may have been slightly different.

61. Authigenic outgrowths on Detrital Piedmontite from the Kamthi Sandstones.

SRIPADRAO KILPADY and G. G. DESHPANDE, Nagpur.

Detrital Piedmontite from the Kamthi sandstones of Silewada area in Madhya Pradesh exhibits authigenic outgrowths. Tooth like, clear and transparent outgrowths with well defined boundaries protrude from the rounded grains of Piedmontite. The authigenic portions have a paler tinge than the host grains and show a faint pleochroism from pale yellow to pale violet. They are in optical continuity with the host grains. While authigenic outgrowths in detrital minerals like Zircon, Tourmaline, Zeolites, Anatase, Brookite, Rutile, Epidote, Garnet are fairly common, this is perhaps the first time that such outgrowths have been noticed in Piedmontite.

62. The Nature and origin of the Sand Dunes on the Western side of Mount Abu.

N. BHATTACHARYA, Banaras.

The region under study includes parts of the districts of Sirohi, Jodhpur and Palanpur and covers an area of about 700 square miles. Here the Sand Dunes are mainly of four different types, classified as—dunes, sand drifts, sand sheet, and sand hills. The dunes are also of two types—the 'Self' and the 'Barchan', in each case the windward face is convex with a gentle slope while the leeward face is concave with steep slopes. Their crests are sharp and quite uniformly straight which is somewhat surprising. Some of the dunes, and more particularly, the sand sheets, are often marked by ripple like designs. The sand hills which are generally fixed by vegetation are sometimes ravined as a result of intermittent and torrential rainfall.

The dunes are all composed of desert sand, partly brought by the wind from the Runn of Cutch under the action of the prevailing winds and partly made up of the ultimate disintegrated debris left as a result of mechanical weathering of the rocks under arid conditions. Their morphology is influenced by aeolian action 'in conflict with vegetation', under a semi-arid climate.

63. Heavy Mineral Assemblages of Talchir and Karharbari Sandstones in the Giridih Basin, Bihar.

C. NARASIMHARAO, Kharagpur.

The paper presents a comparative account of the heavy mineral set up of the Talchir and Karharbari sandstones collected from the Giridih Basin, Bihar. In order of decreasing frequency, the following non-opaque heavy minerals are identified in the rocks.

Talchirs :—Garnet (colourless, pink and brown), Muscovite, Chlorite, Zircon, Tourmaline (green and brown), Rutile and Apatite.

Karharbaris :—Garnet (pink, colourless and brown), Muscovite, Zircon, Tourmaline (green, brown and blue), Hornblende, Spinel (green) and Rutile (sporadic).

The significant differences between the two formations appear to be the absence of spinel and hornblende in the Talchirs and the disappearance of epidote and chlorite in the Karharbaris. Hornblende makes its presence in the topmost horizons of Talchirs and continues almost without a break throughout the Karharbaris. Rutile which is a constant mineral in the Talchirs makes only a sporadic appearance in the overlying Karharbaris. Flooding of garnets is noticed in three particular horizons in both Talchirs and Karharbaris.

The work done so far indicates that a more comprehensive statistical study of the heavy mineral data might yield results of critical value in evaluating the provenancial history of these sediments.

64. Shape Analysis of Quartz sand grains, S. E. Raniganj Basin.

MILAN KUMAR SEN, Calcutta.

Three units of the mechanical analysis, i.e., three size grades (0.5-0.35; 0.35-0.25 0.25-0.177 mm.) were utilised for the study of the nature of variation of sphericity (Wadel, 1932; Tuckell, 1931) and the relation between the size and shape of the quartz grains of the Raniganj and Panchet sandstones (Raniganj Coal Field Map No. 14) systematically collected from both sides of the grit bed. The grain

were projected and drawn with the help of a camera lucida on a centimeter graph and the 'sphericity numbers' were determined.

The sphericity numbers of the grains of Panchet sandstone lie within 0.588 to 0.745 whereas in the Raniganj sandstones grains they lie within 0.570 to 0.831 and it is to be noted that sphericity number of all these grains show almost no correlation to size.

The 'mean deviation' varies from 0.0584 to 0.0685 in quartz grains of Panchet sandstones and 0.0675 to 0.0713 in Raniganj sandstones whereas 'standard deviation' varies from 0.0697 to 0.0825 in the former and 0.0791 to 0.0842 in the latter.

The 'b/1' ratio was plotted against '1' as the independent variable (Hagerman, 1933) and the scatter diagrams thus obtained for the quartz grains of Panchet and Raniganj sandstones (generalised for three size grades) plot within irregular to roughly elliptical fields. On super-position these distribution fields show some amount of correspondence. The maximum concentration of 'b/1' ratio lies within 0.7 to 0.9.

Since the two values '1' and 'b/1' are measurable quantities that vary continuously and are independent of each other, the correlation coefficient (r) was calculated and a moderate negative correlation (-0.687 to -0.792 in grains of Panchet sandstones and -0.756 to -0.815 in Raniganj sandstones) was obtained. The negative correlation indicates that in the measured grains within the limits of the 'b/1' ratio, the smaller grains tend to be equiaxial than the bigger ones.

65. Mechanical analysis of Raniganj and Panchet Sandstones, S. E. of Raniganj Basin.

MILAN KUMAR SEN, Calcutta.

A.S.T.M. sieves were used in the Mechanical analysis of statistically representative outcrop spot samples from Raniganj and Panchet Stages (Raniganj Coal Field Map No. 14), collected in rectangular grid pattern. The fraction below 0.062 mm. has been further graded by pipetting.

The frequency polygons from the size grade distributions of the samples of both the Raniganj and Panchet Stages show a conspicuous peak, in most of them within the grade 0.5 mm. to 0.35 mm.

Beside this chief peak of the frequency polygon, usually one minor peak within the grade 0.031 mm. to 0.0156 mm. (sometimes slightly shifted) in the Raniganj samples and two within the grades viz (0.062 mm. to 0.031 mm.) and (0.0078 mm. to 0.0039 mm.) in the Panchet samples are noticed. Usually, all the peaks have maintained a constancy with respect to size grades but the fluctuation in the steepness of the peak is not infrequent. The value of Trask's "sorting coefficient", S_o , lies in most of the samples within 1.39 to 1.78 revealing that the sediments in general are well sorted in both the Raniganj and Panchet Stages. The degree of sorting is, however, greater in the Raniganj than in the Panchet Stage.

The samples of the two Stages, show the variation of \bar{x} (arithmetic mean size) between 0.241 and 0.685. The median value maintained a general constancy in the position with respect to size grade. The values vary within 0.251 mm. to 0.365 mm. Since with the same mean value, the size distribution may be different in the variates, mean deviation (d) of the variates from this Central point and the standard deviation (σ) have been calculated. The deviation is usually high suggesting the grading to be imperfect. The values of \bar{x} , d , (σ) etc. vary widely in a few cases which is due to the unequal distribution of frequency at the smaller class intervals within the broader ones.

The evidences collected suggest small scale seasonal fluctuation associated with each lithologic unit; but primary peaks decidedly indicate the nature of general grading of the transporting medium depositing both the stages. The greater prominence of the minor peaks in the Panchet stage samples positively indicates a more vigorous change in the seasonal climate.

(vii) Groundwater.

65A. Notes on the Geology and Groundwater conditions of certain parts of the Mahendragarh District, PEPSU.

G. C. CHATERJI and A. B. BISWAS, Calcutta.

The paper embodies the results of geohydrological observations carried out in the northern and east-central parts of the Mahendragarh district, PEPSU, during the 1953-54 and 1954-55 field-seasons of the Geological Survey of India. The area lies between latitudes $28^{\circ} 5' : 28^{\circ} 45'$ and longitudes $76^{\circ} 0' : 76^{\circ} 30'$ in the Survey of India Topographical sheet No. 53D and is roughly 800 square miles in extent.

The work consisted mainly of determining the ground-water potentialities of the area with special emphasis on quality of water. The relevant hydrological data comprising depth to water, hydraulic gradients, etc. were collected from the inventory of about 600 dug-wells located in the area. Besides, geological mapping was also carried out to delimit the areal extent of the hard and soft rock formations which have a significant bearing on the possibilities of groundwater development.

The climate of the region is semi-arid. The average annual rainfall ranges from 18 inches at Narnaul ($28^{\circ} 3' : 76^{\circ} 7'$; 53D) to 16 inches at Dadri ($28^{\circ} 35' : 76^{\circ} 16'$; 53D).

The area consists of fairly level to gently undulating alluvial and sandy plains, interspersed by sand dunes, isolated *hillocks* and ridges. The region is devoid of any effective drainage system.

The hard-rock areas are occupied by the rocks of the Delhi system which are classifiable, in the area studied, into the Alwar series and Ajabgarh series in order of antiquity. The Alwar series is composed mostly of hard and compact quartzites while the Ajabgarh series consists of mica-schists and calc-silicate rocks. The general strike of the beds varies between N-S and NNE-SSW.

Rainfall forms the chief source of the groundwater which occurs in a fairly thick zone of saturation within the alluvium. The exact depth, extent and nature of alluvium which constitutes more than 98% of the area is not, however, precisely known. But from the study of the formation logs of three bore-holes recently drilled in the Dadri area it is found that the alluvium there is not less than 341 feet in thickness, but in the south it gradually thins down often to a depth of 60 feet below ground surface. At Dadri it is reported that alluvium consists mainly of clay and *kankar* with subordinate amount of sand. The depth of water usually varies from 50 to 100 feet, but in the area west of the west-central ridges it is much deeper.

The shallow groundwater occurring in the area is generally brackish, while in the extreme northern and east-central parts it is highly mineralized and characterised by a very high concentration of chloride-ions and total hardness. Partial chemical analyses of some 260 water samples reveal that the concentration of chloride-ions ranges from 10 to 8,000 parts per million and that of bicarbonate ranges from 120 to 2,220 parts per million. The total hardness content shows a variation from 40 to 8,200 parts per million.

B. GEOGRAPHY.**(i) Physical basis of Geography and Geomorphology.****66. Summer Concentration of Thermal Efficiency as an Index of Thermal Continentality**

V. P. SUBRAHMANYAM, Waltair.

The paper describes the application of the summer concentration concept of Thornthwaite to the study of the continentality of the Indian sub-continent and the results are compared with the continentality factors derived from the modified Zenker formula given by Conrad. The strong parallelism between the curves of latitudinal variation of the coefficients obtained by the two methods indicate that the former could as well be used for the purpose. The one definite advantage of the summer concentration approach is that it always gives positive values while the usual Zenker formulae or their modified analogues sometimes give for the continentality coefficient negative values that carry no physical meaning.

The curves of variation of the coefficients with latitude for the Indian sub-continent are shown in the accompanying figures and the author is of the opinion that the peaks and troughs exhibited by the curves are presumably connected with the strong relief contrasts at the corresponding latitude belts.

67. A Note on the Distribution of Temperature in Madhya Pradesh.

BHALCHANDRA K. BIDVAI, Amravati.

The paper analyses three maps showing the Annual March, the Mean Annual Range, and the Mean Annual Temperature for Madhya Pradesh. The monthly curve shows two maxima, the principal, and the subsidiary. The time of occurrence, however, varies in the eastern and the western parts. The amount varies too according to the elevation of the land. The mean monthly maximum and the mean monthly minimum curves show the twin influence of relief and rainfall. The mean annual isotherms relate to two thermal systems, and the mean annual range of temperature to three systems.

On the basis of these maps Madhya Pradesh may be divided into 4 tracts : (1) Jabalpur-Pendra or Northern tract which is the warmest, (2) Kanker-Jagdarpur or South-eastern tract which is hot, (3) Khandwa-Raipur or Central tract which is hotter, and (4) Nagpur-Berar or South-Western tract which is the hottest.

68. Aridity at Jacobabad.

SHYAM SUNDER BHATIA.

It is usual to speak of the aridity of a place on the basis of its rainfall. But rainfall alone is not an adequate measure of the aridity of a place. The term aridity expresses deficiency of moisture and a consideration of only the rainfall of a place cannot give any idea as to how far the rainfall is deficient. In the hydrological cycle, water is transferred from the atmosphere to the earth's surface through the phenomenon of rainfall and from the earth's surface back to the atmosphere through the phenomenon of evapotranspiration. But for our purpose, we need to know potential evapotranspiration which is the evapotranspiration that would take place, if water were available. (Potential evapotranspiration is also called water need.) A comparison of potential evapotranspiration with rainfall would indicate the deficiency of rainfall.

Use has been made of the above concept and potential evapotranspiration at Jacobabad has been calculated according to Thornthwaite's method. The extent of aridity and its march through the year at Jacobabad have been determined and discussed in this paper.

69. Some geographical aspects of the fishing industry in Lower Kali Basin, North Kanara District, Bombay State.

M. S. HONRAO, Dharwar.

The importance of the Fishing Industry in the Lower Kali Basin lies not only in the fishing population but also in the contribution that the industry can make towards complementing the rice diet of this basin. Like agriculturists and foresters, the fishermen too are an important economy of the basin. From this point of view the industry stands third, and yet sustains a large element of the population.

The general poverty of the resources of the basin has forced the people to seek their livelihood more from the sea. Natural conditions are very favourable to the industry. The broad expanse of the shallow sea, the indented coastline marked by alternate headlands and bays, the advancing coast, the abundance of the food for fish, absence of surface currents, and many other conditions combine to produce an environment in which the most varied types of fish can find a suitable habitat.

The extension of the continental shelf for many miles out to the Arabian sea has given a large fishable area of which hardly 20 per cent is being consistently exploited.

The activities of the fishermen are controlled by the geographical conditions prevailing in this basin. Coastal fishermen show a marked seasonal rhythm while the creek fishermen show a daily rhythm. Monsoonal, Post-monsoonal, and Pre-monsoonal activities of the fishermen varies in intensity and kind of work.

Markets for fish are of two kinds—fresh and cured. Fish are cured by various methods, because different markets demand different types of cured fish.

That the industry is capable of considerable further expansion is certain, though it has shown a steady growth so far. Coastal waters could be far more intensively fished than at present.

The problems of the industry are mainly those of the fishermen themselves. They are illiterate, poor, and have no initiative. Providing finance to purchase powerful equipment would help to increase production. Organising facilities of preservation, transport and profitable marketing is wanting but is essential. All these collectively would gear up the prosperity of the industry.

70. Soils and settlement patterns of the Tanjore District.

M. S. VISHWANATH, Banaras.

Tanjore District is a deltaic tract made up wholly of the silt brought down by the river Cauvery from different regions. So, there is a diversity in the soil types. Agriculture is the main industry from ancient times and the villages here, are chiefly dependent on the soil. They are so well adapted to the soil and climatic conditions that those which were established in a certain form have remained so till this date.

Mainly, there are four types of soils, viz., (1) Alluvial, between the rivers Cauvery and Coleroon comprising the taluks of Tanjore, Papanasam, Kumbhakonam, Mayavaram and Nannilam, which is the most fertile region in the area. (2) Next comes the Regar or black soil which is much different in origin and mode of formation from the black cotton soil of the trap area. This is found in almost all parts except Pattukottai, Orathanad, and Aranthangi taluks. (3) The Red Ferruginous

soil is the main feature of the 3 taluks mentioned in item (2) above. This is very infertile and is further divided into Lateritic soil of a secondary origin capping the Vallam Table Land and Sengipatti High Land, and the remaining portion of the Bright Red Soil Region. (4) The Coastal tract which is four or five miles in width is constituted by the Arenaceous or Sandy Soil.

The district has got a total population of 2,542,366 most of which is distributed in the 2,511 villages. The density of population is greatest in Kumbhakonam, numbering 1,474 to a square mile.

The total number of towns are only 22 and the shape of these are classified into triangular, rectangular, semi-circular and irregular. They are illustrated very nicely by Tanjore, Kumbhakonam, Negapatam and Mannargudi respectively.

Villages are the main feature of the district, and these are mostly influenced by the soil types as mentioned previously. The chief types of rural settlements found in the region are Linear, Clustered and Scattered. The first is the striking feature of the Alluvial and the Coastal tracts. In the former, the settlement is spread along the banks of the numerous off-shoots of the Cauvery. The Linear settlements of the Littoral tract is different from that of the Alluvial soil region, in the fact that the former is inhabited by the people who mainly depend on the sea for their food. But, now, owing to the increase in the population the people in the former have taken up land-tilling.

Clustered settlements are found chiefly in the Regar or Black Soil region. Here, they are clustered in groups with a view of division of labour and inter-dependence upon each other.

A third type of settlement is found in the infertile Red Ferruginous soil region of Orathanad, Pattukottai, Aranthangi taluks. Here, the low-fertility provides lesser scope and compels the people by a sort of centrifugal force to live very far apart.

The dwellings in the villages are very primitive except in certain places where stone-walls and tiled roofs predominate, which have replaced the huts after the great cyclone and the thunderstorm of November 1953. The huts have walls generally of mud and thatched roofs on a frame-work of bamboos either by paddy husks or palm and coconut leaves.

71. Morphological analysis of the Malaprabha Basin, Bombay State.

R. V. JOSHI and R. S. GOLLERKERI, Dharwar.

The morphometric analysis of the Malaprabha basin indicates multi-cyclic evolution of this landform. This is emphasised by the high degree of adjustment to structure shown by the drainage, accordance of summit levels at about 2250 ft. and 2050 ft. observable on both the gneisses and Kaladgi formations. The valley near Khanapur suggests the possibility of two terrace level approximately at 2200 ft. and 2250 ft. respectively. Slopes in general are concave in outline indicating waning development. The scarps show three slope units.

72. Changes in the distribution, frequency and intensity of flooding in the Rupnarayan, Kansai and Dwarakeswar Basins, 1823-1938.

P. K. SIRCAR, Calcutta.

All the information relating to the floods of the Rupnarayan, Kansai and Subarnarekha basins over the two 58-year periods, 1823-1880 and 1881-1938, as found in official and non-official publications, was collated and tabulated, showing, for each river, in chronological order, the time of each flood, the area affected by it and the resulting damage. These floods were next classified into categories, according to the severity of damage wrought by it.

A comparison over the two 58-year periods shows that there has been an increase in the total number of floods in the second period, with a maximum increase in floods of the fourth category. Although these floods do only slight damage, their cumulative effect on the regional economy is far from negligible. Catastrophic floods are very rare and absent altogether in the latter period. There has thus been a decrease in the floods of the first two categories and an increase in the last two.

The flood maps show an increase in the frequency of flooding at the Subarna-rekha mouth, and a remarkable extension of flooding near the confluence of the Silai and Dwarakeswar.

73. Profiles as Tools of Map interpretation work.

SIVAPRASAD DAS GUPTA, Calcutta.

Profiles are indispensable tools in all kinds of map interpretation work. Profiles may be fruitfully applied to solve different geographical problems and the way of presentation of the profiles may also be varied. This paper deals with the multifarious uses of profiles and sectional diagrams and indicates the methods of construction of them as applied to different types of map interpretation work.

In this paper the author stresses the need of paying more attention to the question of selection of proper amount of exaggeration in the vertical scales of profiles for use with different kinds of geomorphic analysis. Little attention has hitherto been paid to this problem of choice of correct vertical scale. High exaggeration of vertical scale (which is however very common) carries wrong impression and one must be very careful of it in geomorphic analysis. The author suggests scaling down of the vertical exaggeration to the lowest minimum possible according to the type of work. As far as possible, there should not be any vertical exaggeration when drawing profiles from maps of 1 inch to 1 mile scale. Slight exaggeration may be made in the case of smaller scale maps; but in any case the ratio of exaggeration should be mentioned and preferably a true to scale profile should also be superimposed on the exaggerated one. The author also suggests the use of logarithmically reduced vertical scale where the range of relief is very great and this scale may also be adopted to show foot-hill features more prominently. Since the scale of exaggeration is gradually reduced with heights, the peak areas are not so grossly distorted in this type of scale as in the case of ordinary (geometrically) exaggerated scale. Logarithmic scale may also be used to show the rate of change of slopes.

The paper also deals with the use and the method of construction of various types of sectional diagrams e.g. superimposed profiles, composite profiles, projected profiles, multiple profiles and intersecting profiles; the merits and difficulties of these have also been discussed. The intersecting profile is a new way of depicting landscape and it gives an effect of solidity yet it is not so elaborate as a block diagram. Here the possibility of this new method is suggested for the first time. This diagram is made by drawing profiles along two or more intersecting lines on a map. The profiles are drawn on two or more corresponding intersecting planes. Many novelties may be tried in this line and the use of such diagrams is strongly advocated. Also, various methods of making river profiles and road profiles are discussed in the paper.

74. The Bartala—Matla Interfluve, a Study of Deltaic problems.

KANANGOPAL BAGCHI, Calcutta.

The development of the Science of Hydrology in its wider sense is rather a recent growth in our country. The irrigation Engineers and those concerned with

navigation had maintained a sort of professional exclusiveness and the colleagues in other branches had little knowledge of the characteristic behaviour of streams. Those in charge of agriculture, transport, and the development of human settlements—urban and rural, had no idea as to the extent their activities could and did interfere with the hydrological conditions and the amenities of living. This ultimately led to the progressive dessication of the land with its inevitable human consequences. A study of the moribund part of the Ganges Delta bears full testimony to this. The author was attracted to a study of the active part of the Ganges Delta and to find out for himself as to how things are shaping in that area so that a case for co-ordination could be worked out between the different branches of Science for social and regional plannings.

The observations embodied in this paper relate to the tract between the Bartala and the Matla distributaries of the Hooghly, south of a line joining Kakdwip and Canning.

(ii) Urban Settlement and Economic Geography

75. Allahabad—A Study in Urban Geography.

UJAGIR SINGH, Banaras.

Allahabad, ancient Prayag, like the sacred city of Banaras, has ever since been the chief repository of social tradition, the fountain head of inspiration and the point of contact between the two centres. It's name is associated with Shri Rama Chandra and Muni Bhardwaj whose Ashram still stands on the high old bank of the Ganga. It is here that King Harshvardhan performed his famous Dan-Yajna at the confluence of the blue and white waters of the two sacred rivers, the Ganga and the Yamuna.

The strategic position of Allahabad naturally, attracted Akbar to build a Fort just at the confluence of the rivers, who with a view to protecting the fort from devastating floods of the Ganga also built a strong bund along the river from the fort to the old bank near Prayag Railway Station. This embankment forms a conspicuous element of cultural landscape that succeeded in protecting not only the Fort but also the city, in the east, thus providing a huge tract of low land to the municipal areas for building new residential colonies like the George Town and the Tagore Town.

The impact of the British rule can be seen in the broadly rectangular cantonments and particularly in civil lines in the north with large modern bungalows and offices with spacious compounds and gardens, along the straight and wider metalled roads. The railway colony to the south of Civil lines, enclosed with *Pakka* wall, cannot also be ignored.

To the south of the Railway colony lies the city proper with its comparatively narrow-roads and lanes and crowded aspect being developed on the higher ground close to the high bank of the Yamuna and away from the flood-affected low lands towards the confluence.

The heart of the city lies in the Chauk, at the crossing of the historical Grand Trunk Road and Jhonston Road. It is the main business centre of the town.

The existence of the Secretariate, the High Court, Government Press, the Government House, and several residential colonies indicate the significance of the city's administrative function though it no longer remains the capital of the State. Since 1935 the seat of the State-administration was shifted partly to Lucknow.

The industrial development of the city is insignificant. Few printing presses, however, employ over a thousand persons.

Thus Allahabad blends Hindu, Muslim and European cultures into such a peculiar thread that each having its own ever lasting impressions on the city's pattern has combined to promote harmonious growth of the town.

76. Urban Geography of Orissa.

BICHITRANANDA SINHA, Calcutta.

In this mid-twentieth century 4 per cent of the population of Orissa are urban dwellers but the future seems very bright because of the multipurpose schemes which are under construction. All but a few towns have developed by the side of the rivers and the river Mahanadi controls 52 per cent of the total number of towns. The distribution of the towns can be grouped into three divisions which are identical with that of the topographical features. Coastal region tops in the list with 38.5 per cent of the urban centres and 60.7 per cent of the urban population, while the middle mountainous region has 30.75 per cent of the towns and 17.0 per cent of the urban population. The upper catchment basin has got a population of 22.3 per cent and 30.75 per cent of towns. Almost all the 'old' towns of Orissa has developed in the coastal plains which accounts for 44.0 per cent of the present day number of towns. Out of two dozen of 'war' and 'post war' towns 75.0 per cent of them have sprung up in the interior region of Orissa. Of all the towns of Orissa 77.0 per cent can be classified as 'growing towns' where 5 per cent to 30 per cent of increase in population in a decade has been experienced but majority of the declining and 'slow growing' towns are located in the coastal plains as they stand on a purely agricultural setting and all the declining towns are 'old towns'. The trend in migration of urban people to the upper catchment areas and the middle hilly regions is prominent because of the recent signs of industrial development in those regions. Hence the future regional balance of importance in Orissa will be shifted from the coastal plains to the present day scarcely populated regions and the former coastal belt will remain as a feeding centre of the food resources to the industrial belt of the upper reaches of the Orissa rivers.

A study of housing problem in the Urban centres of Orissa has revealed that there is very little or absolutely no relation between the area of the towns and the pressure of population per square mile. The population does not vary universally nor they maintain any relation with the increase or decrease of the area of the town and also it is not controlled by the occupational character of the urban population. It is controlled mainly according to the time of the development of the urban centres. Old towns are the most congested areas of Orissa. Structurally Orissa is mainly a land of small towns and the majority of the towns are concentrated in the coastal plains whereas smallest ones are found in the forest clad mountainous middle region and the medium type of towns are met with by the side of the rivers in the upper catchment basins. Agricultural towns are found in coastal areas whereas non-agricultural ones are more frequent in other parts of Orissa. Hence any move to improve the economic bases of these coastal towns must primarily be aimed at developing the agrarian economy of the coastal plains. Commercial upliftment in the middle mountainous region will bring immense good to those of the middle region. Absence of nodal centres clearly indicate the lack of a well developed and well-co-ordinated transport and communication system in Orissa.

77. The Geographical Background of the Localization of Cottage Industries and their planning in Uttar Pradesh.

S. M. TAHIR RIZVI and M. HASAN, Aligarh.

The paper attempts to evaluate the location of various cottage industries in the state of Uttar Pradesh as determined by the geographic factors. A rapid survey of some important cottage industries has been made with a view to prove that their existence, growth and development are, more or less, due to geographic factors and their inter-action.

The present demographic position of the State, the disequilibrium which exists between agriculture and industry makes it imperative that cottage industries should receive careful consideration.

Having a large size with high density of population, an agriculturally productive climate, a varied combination of natural resources and a fair industrial capacity, it is in the fitness of things that the State is undoubtedly destined to hold a dominant position in respect to cottage industries which have much scope of further development and expansion in the industrial planning of the State. The Cottage industries, therefore, should be organised and planned under geographical conditions as planning is, of course, an important branch of Geography.

78. Jute Problem of India.

P. SENGUPTA, Calcutta.

The partition of India in August 1947 was one of the outstanding events in the history of Indian jute farming. It split the nucleus of the Jute-belt of Pakistan from the peripheral part in India. In fact, four-fifths of the world's production became centred in Pakistan, while the largest concentration of jute-milling centres remained in India. Thus jute assumed a bilateral monopoly between Pakistan as the major producer and India as the major buyer. Nevertheless, following partition, the jute industry in India passed through a difficult phase owing to scarcity of jute, supplies from Pakistan being uncertain and insecure. As a result, strenuous efforts were made to achieve self-sufficiency in raw jute. From 1946-47 to 1954-55, the land under jute increased by more than 136 per cent and the output by 133 per cent—a fact predicting that India will soon be self-sufficient in her raw-jute supplies. Even so, this terrific growth can hardly be stated as balanced between the geographical and economic factors, and compatible with self-sufficiency in food. To make this 'Grow More Jute' drive a success, it is desirable to encourage the extension of juteland in the region of optimum conditions of climate, soil and relief and correspondingly to check further growth in the region of unfavourable environment. It is further needed to adopt an integrated production-scheme, which would embrace the production of food-grains as well as jute.

79. Emergence of the City Centre in Dharwar, Bombay State : A study in an Indian Urban Problem.

V. R. PRABHU, Dharwar.

The 'core' or 'central zone' holds a unique position in the urban complex. Its emergence and growth make an interesting study and this paper comprises an empirical examination of the phenomenon in Dharwar ($15^{\circ} 30' : 75^{\circ} 0'$).

The evolution of this zone—The City Centre—is considered first. Of this, four broad stages are noticeable. With every stage of expansion is reflected the concentration of different functions in Dharwar (primarily a military and commercial centre; under the British rule acquired administrative and educational functions; and, recently the cultural and university centre of Karnatak) and its growing importance as a regional centre.

After this consideration of how the expansion took place, the *modus operandi* of the factors controlling its form and limits are noted. The responsible factors are the natural and human conditions inseparably bound up with the site, e.g., the physical barrier of the tank, the obstacle of fort, the accidents of land-ownership and cadastral structure; reacting with the planning or spontaneous growth, they have given the City Centre a clear areal expression, amply illustrated by the maps.

80. Evolution of Jamshedpur in its Locational Quadrangle.

N. K. P. SINHA, Banaras.

Jamshedpur enjoys an enviable position in the iron and steel industry of India and holds a unique position in the British Commonwealth. It produces about 8 lac tons of finished steel annually and is the cheapest producer of pig iron in the world and of steel in the country. The works of TISCO, which are located here, have created an agglomeration of heavy industries unparalleled in India. An analysis of the factors of its development as such, exemplifies that Jamshedpur is situated in a Locational Quadrangle formed by joining Calcutta (the chief market), Gorumahisani (the source of iron-ore) Birmitrapur (the source of limestone and dolomite) and Jharia (the source of coking coal). Its location in the Quadrangle coincides with the point of minimum transportation costs of the chief raw materials (viz. iron-ores, coal and limestone) and the finished products.

Jamshedpur is situated at a distance of about 60 miles from the 'Iron-Belt', 117 miles from Jharia, 116 miles from Birmitrapur, 100 miles from the manganese mines of Bonai and Keonjhar, and 152 miles from Calcutta. Its location is, nearer the orefields, somewhat southwards from the mathematical centre of its Locational Quadrangle. This is true because there has been greater attraction for the good quality iron, manganese and chrome ores of Singhbhum and Orissa than for the coals of Jharia. Calcutta has, no doubt, attracted the steel-site, but the combined attraction of ores, coal, and limestone has, by far, superseded its attraction and hence the steel centre is still far away from Calcutta. It is, therefore, clear that considering the relative importance of the different raw materials and the influence of Calcutta, Jamshedpur occupies a position of equilibrium in its Locational Quadrangle and the advantages accruing therefrom have resulted in its development as the greatest steel centre of the sub-continent.

81. The Umland of Agra.

LAL SINGH, Banaras.

The umland of a town includes the surrounding country, which is linked culturally, economically and politically with the town as a centre. The linkage are varied and complex. Dr. R. L. Singh in his recent work, 'Banaras, A study in Urban Geography', has attempted to determine the umland of Banaras by considering the following factors: (1) Vegetable supply, (2) Milk supply, (3) Supply of grains, (4) Bus service and (5) Newspaper circulation. Here the education service may be added as the sixth factor. The author in this paper has taken Bus-service as the basis for determining the umland of Agra.

Buses ply along the routes joining Agra to Aligarh, Mathura, Bharatpur, Dholpur, Etawah and Mainpuri. Besides, local towns such as Firozabad, Batesar, Shamsabad, Tantpur, Jagner and Fatehpur Sikri are also linked to Agra by bus-service.

The umland thus served has an elongated shape, extending from Etawah to Kosi along the Yamuna river, which has to a great extent determined the zone. The Yamuna provided the chief means of traffic movement in the past. Thus most of the urban centres grew either along the river or within a reasonable distance from it. Roads came later and thus were attracted by the towns and the towns were not attracted by them. Later on bus-services were developed along these routes following the river.

There is a slight bulge in the umland towards the southwest. This is due to the development of motor-traffic along the routes leading from Agra to (1) Bharatpur, (2) Fatehpur Sikri, (3) Tantpur and (4) Dholpur. These urban

centres have grown on the fringe of the desert and thus enjoy almost a contact-point location between the Ganga plain and the Rajputana desert. On the south the Chambal river forms the limit.

A possible bulge may be expected towards the northeast, if a metalled road is constructed, joining Etawah, directly to Agra. With this change the umland of Agra may assume a 'Spindle' shape.

This umland of Agra has an approximate area of 3,498 Sq. miles with a total population of about 2,200,000 souls.

82. The Trend of Urbanization in the Umland of Banaras.

R. L. SINGH, Banaras.

The Umland of Banaras is essentially an agricultural country with over 40,000 villages and 83 towns. According to the 1951 census 92·8 per cent of the people lived in villages and 7·2 per cent in towns. Considering their size urban centres have been classified into 6 groups: (i) A city with over 100,000 persons, (ii) a sub-city with 50,000—100,000, (iii) a large town with 20,000—50,000, small towns, (iv) 10,000—20,000, (v) 5,000—10,000 and (vi) under 5,000.

In an essentially agricultural country like this it is quite natural that no urbanized zone has developed in the true sense. There is, however, some considerable concentration of towns in a narrow strip along the Ganga, and the most urbanized region of the umland is the Ganga-Ghaghara—Doab East where a little over one-tenth of the total population lives in towns. The Saryupar Plain is the least urbanized region with 4·1 per cent of urban population. It may also be remarked that the proportion of the total urban population living in various classes of towns increases directly with the increase in their rank. Banaras, the regional capital alone possesses about one-fourth of the urban total, while the towns of class vi have the least share (6·4 per cent) of the total.

Overall trends in urban population as of rural population are very significant. Between 1881 and 1951 the rural population shows a more rapid increase (41·2%) than the urban population (36·5%) but the recent trends indicate reversal of these conditions. Since 1921 the urban population (85·7%) has increased much faster than the rural population (32·4%). Further, since 1881 the proportion of urban population living in large towns and cities has considerably increased, partly due to commercial and industrial developments, particularly after 1921, and partly to immigration from rural areas for employment and better facilities and attractive town life; whereas that of small towns has greatly declined mainly owing to the decline of their cottage industries and trade most of which got concentrated in large towns by the advent of railways.

83. Growth of Population in India and its effects on Rural-Urban Migration.

P. DAYAL, Patna.

There has been a rapid growth of population in India during the last three decades. While during the 30-year period prior to 1921, the net increase in population was only 12·2 million, the population shows an increase of 108·8 million during the subsequent 30-year period. If the average rates for the two 30-year periods are calculated, we find that the population grew between 1891 and 1921 at the rate of 1·7% per decade, but between 1921 and 1951 it grew at the rate of 12·0% per decade. This has resulted in decline of cultivation per capita from 111 cents in 1921 to 84 cents in 1951. In the absence of increase in yield per acre, this must mean a corresponding reduction in the supply of food and other agri-

cultural produce. While there has been increase in the double-cropped area and in the area under irrigation, these have not kept pace with the increase in population. Rural unemployment and under-employment have increased, and there has been an accelerated migration to the cities in search of work. This has, however, been unaccompanied by a proportionate increase in non-agricultural employment. The dependence of the people of India on agriculture and allied activities has not diminished with the drift to the cities, on the other hand, there is a slight increase. There has been a general increase in non-earning dependency. Rural-urban migration, however important from the point of view of the city, is still insignificant from the point of view of relieving pressure on agriculture land. The facts presented above have few regional variations and have an all-pervasive character. They emphasize the great urgency of speeding up a fuller utilization of the country's natural resources. The pace of development, both in the fields of agriculture and industry will have to be faster than the growth of population. Such a development will in all probability further accelerate cityward drift, but cities with modern amenities and a fully employed population are the surest index of economic prosperity.

84. The Impact of Industrialisation on Demographic Pattern in West Bengal.

MANORANJAN CHAUDHURI, Calcutta.

West Bengal is the most important industrial unit in India. The jute, paper, and iron industries were first started in this State. In the present paper an analysis is made of the various industries that have developed in the State. The causes of decline of population in the various parts of the State are mentioned. Reference is made to the causes of changes of population consequent upon the development of industries. Suggestions are made to relieve congestion from industrial areas to prevent industrial erosion.

85. Settlement study in some villages of southern 24-Parganas, West Bengal.

K. N. MUKHERJEE, Calcutta.

The group of settlements under survey bears clear testimony of individuality and personality. A slightly higher area with low water-table, it has a number of problems interesting from the point of view of human geography. Incomplete and inefficient road-links make the utilization of the outside markets incompatible. Self-centred economy could not develop because of the great attraction of the Calcutta market. Although secular India is not interested in the religious bearing of economic life, here is at least one example, where even side-by-side villages with different faiths, show quite different land utilization and occupational patterns.

86. Agricultural Adjustments to Environment in Sasaram Subdivision, Bihar.

NARVEDESHWAR PRASAD, Banaras.

The agricultural activities of the Sasaram subdivision stand a witness to the fact that the geographical environment is permissive, not mandatory. Its irrigational facilities clearly exemplify as to what extent man has courageously gained supremacy over the nature in the region where she has not been so bountiful.

Although it is a land of farmers, the physiography of the region has limited the areas of cultivation. The rugged surface of the Kaimur plateau, in the south, is mostly uncultivable. Hence, agriculture is almost confined to the northern plain comprising the Older Alluvium of the Ganga Valley. In early times, agriculture was of subsistence type, owing to the marginal character of rainfall and vagaries of the monsoon. Till the middle of the nineteenth century, about 20% of the rich cultivable land was covered with monsoon forests. Later on, the forests were cleared off and the agricultural practices were adjusted to the changing environment. The most important adjustments were made after the completion of the Son Canal System (1875). There was appreciable increase in net area sown as well as in double-cropped lands. The practice of double-cropping has become so much important that in the revenue thanas of Bikramganj and Karghar, the gross area cropped during a year surpasses the total area of the respective thanas. The net area cropped is about 75% in Bikramganj thana and about 84% of the total land in Karghar thana. Of the net area cultivated, about 72% in the former and about 56% in the latter, is double-cropped. Rice covers about 80% of the irrigated tracts; wheat and sugarcane come next.

During the last 20 years, some new tendencies may be noted. The establishment of the two sugar factories at Dalmianagar and Bikramganj and the introduction of the 'Tube-well Irrigation Scheme', in the vicinity of Delhri-on-Son, have led to considerable increase in the acreage of sugarcane. Similarly, the six rice mills, situated in Nokha and its vicinity, have led to appreciable increase in the acreage under rice cultivation around Nokha.

Even now, there is ample scope for further adjustments in the agricultural economy of the subdivision, especially over the Kaimur plateau, if irrigational facilities are provided in the area.

87. Tourist Industry of Kangra, Kulu and Mandi in the Himalayan Beas Basin.

S. L. KAYASTHA, Banaras.

In spite of the fact that India has everything to offer to the tourist—variety of scenery and climate, archeological and historic monuments and a heritage of rich and ancient culture—the tourist industry still remains an insignificant part of our national economy. The Central and State governments are now quite conscious of the importance of this 'invisible trade', especially in earning valuable foreign exchange and as a means of fostering goodwill with other countries of the world. To encourage the foreign as well as the home tourist, the government is taking various measures to provide adequate facilities.

Kangra, Kulu and Mandi are attracting increasing numbers of tourists each year. Situated in the Himalayan Beas Basin, the valleys are well-known for their pristine loveliness. Majestic mountains, fanning glaciers, virgin forests, smiling valleys, mineral springs, historic and religious monuments and the colourful people hold fascination for the tourist. Climate is bracing and hence 'marketable'. Various varieties of fish, including mahseer and trout abound in streams. For the trekker, there are several short and pleasant trips. Numerous peaks provide excellent mountaineering. Large number of pilgrim tourists flock to the temples of Kangra and Jwalamukhi. Fruit is in plenty and the seasonal colourings are superb. In short, these Himalayan resorts are a tourists' paradise.

Most of the tourist centres are served by motorable roads and bus services. A narrow gauge railway line, passes through the heart of the Kangra Valley and is the most scenic railway line in India. Dak bungalows, rest houses and a few hotels provide fairly comfortable residential facilities. Local produce of fruits, vegetables, milk and poultry, is cheaply available.

The importance of tourism in these industrially poor and commercially remote areas can hardly be underestimated. The profits of tourism are shared alike by the tiny hamlets and larger habitations. People find employment as coolies, attendants, muleteers and pony drivers. The artisans and the tradesmen sell their wares, and the agriculturist sells his farm produce. Kangra blankets and Kulu shawls are purchased as souvenirs by the tourist. The people harvest a rich crop in tourism. More publicity and better transport and accommodation facilities are, however, needed to attract larger number of tourists.

SECTION OF BOTANY

President :—PROF. M. SAYEEDUDDIN, B.Sc., M.A. (Edin.),
F.R.M.S., F.L.S., F.B.S.

Abstracts.

(i) **Algae**

1. Preliminary Ecological Survey of the Algal Flora of Annamalainagar.

(Miss) SAROJINI MENON, Annamalainagar.

This ecological study of the algal flora of Annamalainagar was undertaken in order to gain an insight into the nature of the tropical constituents in relation to their seasonal variations and their attendant deviations as compared to the temperate forms.

Algal flora of Annamalainagar exhibits a comparatively very large element of blue-green algae, both subaerial and aquatic. Thirty-two genera have so far been observed among the blue-green algae, conforming to the families *Chroococcaceae*, *Oscillatoriaceae*, *Nostocaceae*, *Rivulariaceae* and *Scytonemataceae*. Most of the orders of the Chlorophyceae are, no doubt, represented, but the number of spp. is meagre, e.g. *Volvocales* (*Chlamydomonas*, *Pandorina* and *Eudorina*), *Chlorococcales* (*Chlorococcum*, *Scenedesmus*, *Ankistrodesmus*, *Coelastrum*, *Pediastrum*), *Ulotrichales* (*Ulothrix*, *Microspora*), *Cladophorales* (*Cladophora* and *Pithophora*), *Conjugales* (*Spirogyra*, *Sirogonium*, *Zygnema*, *Closterium*, *Cosmarium*), *Oedogoniales* (*Bulbochaete*, *Oedogonium*) and *Charales* (*Chara*).

Occurrence of narrow filamentous forms in the generally stagnant waters of Annamalainagar is very common, only exceptions being *Cladophora*, *Microspora* and *Spirogyra*. It is a well-known fact that the narrowness of the filament is an adaptation to thrive in poorly-aerated waters. But the gregarious occurrence of broad filamentous forms like *Spirogyra*, *Cladophora*, and *Microspora* in stagnant water has not been physiologically explained hitherto. This may be due to the fact that by virtue of their being possessed of large chromatophores, the broad filamentous algae are able to photosynthesise a very large volume of oxygen and are thereby able to make up the deficiency of oxygen in the stagnant waters in which they thrive. Experiments to confirm these observations are in progress.

Epiphytic diatoms are quite common. This character may be an adaptation to escape the higher temperature of water at its surface.

2. Algal Food of some Local Fishes.

V. P. SINGH, Delhi.

Seven species of fishes (*Chela* sp. *Ophicephalus punctatus* Bloch., *Mystus bleekeri* (Day), *Puntius sophore* Ham., *Esomus danricus* (Ham.), *Ambassis ranga* (Ham.) and *A. baculis* (Ham.) have been examined for their gut contents. Algae form from 15 per cent—20 per cent of total food in *Chela* sp., 5 per cent—10 per cent in *Ophicephalus punctatus* and *Mystus bleekeri*, 15 per cent—20 per cent in *Puntius sophore*, 20 per cent in *Esomus danricus* and 5 per cent in *Ambassis ranga* and *A. baculis* when they are from 1.8"-2.4", 2"-2.5", 1.5"-2", 1", 1" and 1.3"-1.5", respectively. Forty four species of algae have been recorded from *Chela* sp., thirty one from

Esomus danricus, thirty from *Puntius sophore*, twenty seven from *Mystus bleekeri*, nineteen from *Ophicephalus punctatus* and only seven from *Ambassis ranga* and *A. baculis*.

Fingerlings of *Labeo rohita*, when kept only on a particular diet of organic matter in the form of *Microcystis aeruginosa*, *Euglenineae* and *Chlamydomonas* sp., were found to be taking them in enormous quantities but in a decreasing order. This may indicate that there is a certain degree of selection of algal food by the fingerlings.

3. Myxophyceae of Visnagar—North Gujarat.

S. Y. GUPTE, Visnagar, N. Gujarat.

Here an effort has been made to record for the first time the various species of Myxophyceae, occurring within the area of two miles of Visnagar, a town in Mehsana District, North Gujarat. So far only 14+5 species of Myxophyceae are available, out of which 14 species are described, the rest being not yet identified. All the species mentioned, are recorded in other parts of India, but many of them differ in their environments. It was noted during the collection from 1950-54, that none of the species of genus Rivulariaceae was available within the said area, but it was found to occur in abundance in Vadnagar, a place only eight miles from Visnagar. Thus the author feels that such local records together with the note of their environments, may bring into light, some new species of Algae, as well as some ecological factors concerning the growth and distribution of Algal species in that area.

(ii) Fungi

4. Canker disease of Citrus plants in West Bengal.

KRISHNA MUKHERJI, Calcutta.

In West Bengal, in the plains, different varieties of lemon (*Citrus limonia* Osbeck) grown on a commercial scale suffer badly from the attack of canker. The disease causes lesions on the leaves, young twigs and occasionally on the fruits which however do not appear to be much affected. Canker lesions on leaves are more numerous and they are often prematurely shedded off. Infections of canker have also been noted on pummello (*Citrus grandis* Osbeck) which has been stated to be resistant by Fawcett. In the initial stage, appreciable damage is not noticed. With the progress of the disease, the plants become dwarf in appearance and have fewer small sized leaves. Bearing is also adversely affected. Fruits with canker lesions always have much less commercial value.

The organism responsible for the disease was isolated and was identified as *Xanthomonas citri* (Hasse) Dowson. Artificial inoculation experiments show that oranges and pummellos are more resistant than the lemons which develop lesions within 15-20 days of inoculation. Certain measure of success in controlling the disease can be achieved by deep pruning and spraying with 0.4 percent Perenox. Use of canker-affected plants as scions in grafting helps in rapid spread of the disease.

5. Addition to our knowledge of Rusts of Hyderabad—II.

M. A. SALAM and P. RAMACHAR, Hyderabad-Dn.

The present contribution is a continuation of the work which the authors started to record the species of rusts occurring on various angiospermic hosts in the

vicinity and in the forest reserve of Hyderabad. The material for this paper was mostly collected from the luxuriant and deciduous forest of Narsapur, situated at a distance of 36 miles from Hyderabad City.

In the present communication 16 species of rusts have been reported for the first time from Hyderabad, out of which two i.e., *Ravenelia Sayeedii* and *Aecidium barleriae* are described as new species. *Abrus precatorius* L., has been recorded as an additional host for *Ravenelia odorata*.

6. On some *Aspergilli* new to India.

S. B. SAKSENA, Saugar.

In this paper two species of *Aspergillus* namely *Aspergillus niveus* Blochwitz and *Aspergillus sclerotiorum* Huber which are reported for the first time from India, are described in detail. These species were isolated during the course of ecological study of soil micro-fungi of forest soils of Sagar and its neighbouring areas. *Aspergillus niveus* was collected twice, once from a forest soil in which *Butea monosperma* O. Ktze, *Diospyros melanoxylon* Roxb. and *Anona squamosa* Linn. were the dominating tree species and the soil was dark-brown and loamy with a pH 7.5. The fungus was recorded upto the depth of 12" in soil. Second time it was recorded from an adjoining grassland soil in which *Dichanthium annulatum* Stapf., *Bothriochloa pertusa* Willd. and *Iseilema anthophoroides* Hack. were the dominant grasses. The soil was black, clayey loam with a pH 7.5.

With the addition of these two species the total number of valid recognisable species of *Aspergillus* in India is now raised to twenty nine.

7. A contribution to the knowledge of Indian *Penicillia*.

S. B. SAKSENA, Saugar.

During the course of the studies of microfungi of forest soils of Sagar the writer came across with six species of *Penicillium*. Out of these two species namely *Penicillium terlikowski* Zaleski and *Penicillium funiculosum* Thom were not reported earlier from India. In this paper these have been described in detail. *Penicillium terlikowski* was isolated from a forest grassland soil which was black, clayey loam with pH of 7.5. Two strains were collected of *Penicillium funiculosum*. One of them, which agrees closely with the description of culture No. NRRL 1132 (Raper and Thom P. 619), was isolated twice, once from the above mentioned grassland and then again from a forest on alluvial soil with a pH of 7.5-8.0. The other strain which agrees closely with the description of culture No. NRRL 1035 (Raper & Thom P. 619) was also collected from two different soils, once from a forest soil on a midslope of a hill which was rich in lime (2.5 per cent) and the pH was 7.5. Second time it was recorded from a soil of a scrub forest with a pH of 6.5. It appears that *Penicillium funiculosum* is fairly common in the soils of the area investigated.

8. Interfertility phenomenon in *Ganoderma lucidum* (Leyss.) Karst.

ANJALI SARKAR, Calcutta.

Pairing experiments with 16 single spore cultures of *Ganoderma lucidum* indicate that the fungus is heterothallic and it exhibits 'tetrapolar' type of interfertility. This was done by isolating 16 monosporous cultures from a single sporophore on *Swietenia masagoni* collected in September, 1954. They were grown in pairs in all

possible combinations and it was evident that the single spore cultures fell into 4 groups on the basis of their ability to form dicaryotic mycelia, recognisable by the presence of clamp connections. In species showing this type of heterothallism, it has been generally assumed that the ability to pair in such a way as to produce dicaryotic mycelia is determined by the "occurrence and independent assortment of allelic determining factors at two genetic loci".

9. A preliminary observation on the control of pest on the leaves of *Amaranthus viridis* Linn. by irradiation with infra-red rays.

S. SUNDARAM, Annamalaiagar.

An experiment was conducted by irradiating seedlings of *Amaranthus viridis* Linn. by infra-red rays emitted out of "Infraphil" lamp of 40 Watts. from a distance of 24 inches for a total period of only five minutes with a view to control certain pests which devastate the leaves. The leaves of the plants are used in dietry for culinary purposes.

The experiment was conducted for one season and the preliminary results have been presented here for what they may be worth. As compared to the control plants, the experimental plants :

1. had flowered a little earlier
2. were much more vigorous in growth
3. were practically free from insect attack
4. longevity has been increased by about 8 weeks and the plants are still thriving in their full vigour in the experimental Botanic Garden of the University whereas the control plants succumbed to the pest, died and dried off about 8 weeks back.

Further experiments in the same line are being continued.

10. Studies on Perithecia Formation in *Penicillium vermiculatum* Dangeard.

A. DAS GUPTA and P. N. NANDI, Calcutta.

A strain of *Penicillium vermiculatum* Dangeard isolated in this laboratory was found to produce perithecia, asci, and ascospores only on malt-agar and not on P.D.A. (potato- dextrose-agar) and C.D.A. (Czapek Dox agar) media. When 2 per cent malt extract solution was rendered colourless by adsorption in activated charcoal, formation of perithecia was not hampered. Thus, the active factor responsible for perithecia formation was not coloured.

Biotin and thiamin did not induce production of perithecia when added in various concentrations individually or in combination. Yeast extract when added to Czapek Dox Agar did not also favour production of perithecia.

Several carbon sources were tried, replacing glucose in C.D.A. without any effect. Of the nitrogen sources tried, replacing NaNO_3 in C.D.A. Tryptophane induced production of perithecia.

Colourless malt solution (charcoal adsorbed) responded positively to the para-dimethylamino benzaldehyde test indicating the presence of tryptophane or some other indole compound.

Though it cannot be said at the present stage whether the active factor in malt is tryptophane or its analogue, it can be said that the fungus is deficient in tryptophane so far as the production of perithecia is concerned.

11. Antibiotic Activity of *Penicillium vermiculatum* Dangeard.

S. K. MUKHERJEE, G. P. SEN and P. NANDI, Calcutta.

A strain of *Penicillium* isolated from West Bengal soil possessed antagonistic action against *Staph. aureus*, *Str. viridans*, *E. coli*, *Eb. typhosa*, *Enterococci*, *Curvularia lunata*, *Helminthosporium oryzae* and *Alternaria solani*. The strain was identified as *Penicillium vermiculatum* Dangeard. The strain was found to be more active against gram-positive bacteria than against gram-negative bacteria. The highest antibiotic titre was obtained using Czapek's medium with 1 per cent glucose+1% sucrose as C-source. The antibiotic principle was thermolabile in nature. Methods of partial purification of the active substance were given. Recovery was 4-5%.

12. Occurrence of *Botryosporium* in India

B. PADHI, Cuttack.

A couple of species of *Botryosporium* Corda have been recorded from Europe and America, growing under artificial conditions of green houses, on decayed plant material. They have never been recorded from India in the past. But this paper records and describes *B. longibrachiatum* (Oud.) Maire (Mason, 1928) from Cuttack, growing profusely and luxuriantly on decayed plant material in the field, both in the rainy season and the winter.

Conidiophores of the fungus are assurgent, long, slender, simple below, hyaline, producing in acropetal order numerous lateral branches, ultimately of nearly equal length. These laterals bear on slightly inflated tip about five short branchlets which end up in several globular heads of conidia. Conidia are sessile, not catenate, hyaline, one-celled, ovoid. *En masse* the growth is brilliantly white in colour.

13. Effect of Phosphatic fertilizers on the incidence of infection of *Helminthosporium oryzae* Breda de Haan on Paddy.

N. K. CHAKRABARTI, Calcutta.

Application of Phosphatic and potash fertilizers has generally been regarded as conferring resistance to the attack of disease particularly in respect of Blast disease of Paddy (Nishikado, Sundararaman and Krishnaswami).

To find out whether the application of Phosphatic fertilizers can influence the incidence of infection of *Helminthosporium oryzae* Breda de Haan on paddy, an experiment was laid on Bhasamanik variety of paddy with Bone-meal as the source of P_2O_5 , in State Agricultural Farm, Chinsurah, West Bengal, at the rate of 0lb, 20 lbs., 40 lbs. and 60 lbs. of P_2O_5 per acre. The experiment was carried on for three consecutive years on replicated and randomized plots. Data were taken on leaf infection and of grain infection. The leaf infection value has been obtained by comparing the leaves (25 leaves per plot formed a sample) with the standard 'leaf infection chart' used in the Mycology section of State Agricultural Research Institute, West Bengal. In respect of grain infection number of spotted grains in a sample of three earheads per plot was noted. Results of the experiment on statistical analysis showed that application of phosphatic fertilizers did not have any effect either on leaf infection or on grain infection.

14. Preliminary Studies on Sporulation of *Bacillus* in Fluid Medium.

S. K. MAJUMDER and M. C. PADMA, Mysore.

A number of bacterial insect pathogens belong to the genus *Bacillus*. The success of the bacteriological control method for insect pests is dependent on the

production of the entomophagus virulent spores of *Bacilli* in mass scale, preferably in liquid media. Effects of sugars in broth on sporulation of *B. subtilis*, *B. megatherium*, *B. cereus* and *Bacillus sp.* (HB III) pathogenic on *Heliothes obsoleta* F larvae were studied. Amongst the sugars examined, lactose could stimulate sporogenesis in the organisms. Studies on different concentrations of peptone and lactose, in nutrient broth were made in this respect. A technique has been evolved as a result of this study to harvest maximum crop of spores from a fluid medium and has been reported in this paper.

15. Pathological Studies of *Pestalotia mangiferae*.

R. N. TANDON, U .S. SISODIA and K. S. BILGRAMI, Allahabad.

Pestalotia mangiferae has been observed on leaves of *Mangifera indica* at Allahabad and Madras. The pathogenicity of this organism has been established on leaves, stem and fruits of mango and symptoms have been described. Cross inoculations on *Psidium guajava*, *Mimusops hexandra*, *Butea frondosa*, *Eucalyptus sp.* and *Citrus sp.* were unsuccessful. Storage of fruits at temperatures below 8°C prevented fruit rot. Dusting the leaves with zinc sulphate controlled the disease but similar dustings on fruits failed to control the rot.

16. *Curvularia pallescens* Boed., on *Accidium urginiae* sp. nov.

P. RAMACHAR, Hyderabad-Dn.

In this paper the author reports the occurrence of a rust fungus on *Urginea indica* Kunth, a member of the Liliaceae, which does not seem to have been reported so far. The rust showing the two spore-forms namely the aecia and pycnia is described as a new species. The paper also reveals an interesting observation that is made while trying to work out the life-history of the rust. In the early stages of the attack the spore forms were well noticed, later the aecia were found to be covered with a purplish black covering of some other fungus. Microscopically this could be mistaken for the telial stage of the rust. Microscopic examination of the hyperparasite reveal it to be one of the fungus of the fungi imperfecti group belonging to the Phragmosporous dematiaceae. The characteristic appearance of the conidia led the author to identify the hyperparasite as *Curvularia pallescens* Boed. The morphology of the fungus is described in this paper. The author reports the failure of the occurrence of the telial stage of the rust and reasons out, that it is due to the total destruction of the aecial spores before they are dispersed from the aecial cup, thereby preventing further development.

17. Varietal resistance of gram to *Fusarium* wilt.

S. K. CHAUHAN, Agra.

In an attempt to ascertain varietal resistance of gram wilt (caused by *Fusarium orthoceras* App. and Wr.) a short series of pot culture experiments were conducted during the rabi 1955 using four varieties of gram, (1. Agra Local, 2. Agra Selected, 3. N. P. 58, and 4. T 85) in Agra soil where wilt is common. The soil of the pots was uniformly infected with the fungus. Six replications were maintained throughout for each variety. The controls were kept in uninfested soil where the plants remained healthy throughout. When the wilting started the number of plants affected each day was recorded separately for each pot. The mortality figures relate to an average of 10 plants per pot and the mean of six pots of each variety. The

final mortality figures statistically analysed are : 4.8 for Agra Local, 3.0 for Agra Selected, 0.7 for N.P. 58 and 0.2 for T. 85, the 'critical difference' being 1.8.

Thus, the incidence of wilting is 48 per cent in Agra Local, 30 per cent in Agra Selected, 7 per cent in N.P. 58 and 2 per cent in T. 85. These experiments suggest the desirability of testing varietal resistance on an extensive scale to obtain results of some practical value.

18. Observations on Certain Soil Conditions Affecting *Fusarium* Wilt of Gram.

S. K. CHAUHAN, Agra.

Wilt of gram caused by *Fusarium orthoceras* App. & Wr. has been studied in relation to certain soil factors. Two types of soil, manured and unmanured, distinctly acidic and alkaline (pH—6.0 and 8.5 respectively) with two levels of soil moisture (low and high) were considered. The experiments were conducted in pots. The soil of each pot was inoculated uniformly and ten seeds of gram were sown in each pot. Six replications were maintained. One set of control in uninoculated soil was also kept where all the plants remained healthy throughout. The pathogen was reisolated from the wilted plants.

When the wilting started the mortality was recorded at regular intervals for each treatment in each pot separately. The figures for total mortality have been analysed statistically. The effect of individual factors as well as their interactions is significant, indicating the importance of the study of the influence of a combination of factors. Certain suggestive indications have been obtained but much detailed experimentation is needed for any reliable conclusions.

Considering the influence of the three soil factors individually and independently, it has been seen that in distinctly alkaline soil (pH—8.5) the percentage mortality is 67 compared to 37 in acidic soil (pH—6.0). Soil moisture by itself does not seem to have much pronounced effect on the mortality. Similarly manuring with compost without interactions with other two factors lowered the mortality by 13 per cent. The data for individual factors and those for interactions of first and second orders indicate that mortality due to wilt in the field is determined by a combination of several factors; the effect of an individual factor may be entirely different when interacted by others.

19. Chemistry of Diseased Fruits of *Coriandrum sativum* L. Affected by *Protomyces macrosporus* Ungl.

J. S. GUPTA, Agra.

The fruits of *Coriandrum sativum* L. are extensively used as condiment in the preparation of curry powder, pickling spices and sausages. By employing standard official analytical methods, chemical constituents were determined in healthy and diseased fruits. It was found that total nitrogen and fat contents decreased in diseased fruits by approximately 0.35% and 14% respectively; whereas total moisture, fibre and mineral matter increased by 0.3%, 25% and 1% respectively.

20. Effect of Certain Chemicals, Antibiotics, and Fungicides on Germination of *Chlamydo*spores of *Protomyces macrosporus* Ungl.

J. S. GUPTA, Agra.

Protomyces macrosporus Ungl. attacks *Coriandrum sativum* L. causing hypertrophy in stem, leaves and inflorescence. The recurrence of the disease is due to chlamydo spores which fall in the soil from the infected parts at the time of maturity and cause infection next year. Germination of chlamydo spores was

studied in respect of distilled water, tap water and 1% soil extract solution to examine the optimum conditions of germination. Some fungicides like Perenox and Agrosan and certain sulpha-drugs like sulphathiazole and sulphadiazine were used to detect fungicidal action, if any. Both the fungicides inhibited germination. Percentage of germination was reduced in dilute doses (0.025% and 0.05%) of sulpha-drugs but higher doses (0.1%) proved to be quite toxic. Among the antibiotics tested, streptomycin lowered the germination percentage but in dilute doses of penicillin it was fairly good. Formalin (0.5 and 1%) completely inhibited the germination of chlamydospores.

21. An *Actinomyces* antagonistic to *Alternaria solani* and *Helminthosporium oryzae*.

K. C. BASU CHAUDHURY, Agra.

An *Actinomyces* isolated from the soil of local fields was found to possess fungistatic properties active against *Helminthosporium oryzae* causing a serious disease of rice and *Alternaria solani* the causal organism of the Early Blight of potato.

(iii) Pteridophyta

22. On the systematic study of Indian *Marsileas*, so far a neglected subject.

K. M. GUPTA, Jodhpur.

Although some morphological and physiological work has been done on some widely distributed species of *Marsilea*, the systematic work has been completely neglected. On examination of the material available in Rajasthan, it has been found that the local flora is represented by at least four species, out of the nine so far recorded from the Indian sub-continent. This includes a new species and *M. aegyptiaca* Willd. which has been reported by the author only last year from Jodhpur and for the first time from India.

As there exists enough confusion with regard to the specific characters of these ten species including even the better known north Indian species like *M. minuta* and *M. quadrifolia*, it was decided to take up this work at Jodhpur. As a result of the examination of the available material and advice from friends, particularly the authorities of the Kew Herbarium, it has been possible to indicate clearly the specific characters that delimit our nine Indian species. These characters mostly pertain to the external and internal structures of the sporocarps besides their mode of attachment to the petioles.

The detailed work that is going on in the laboratory with a view to make a monographic study of the genus in India includes both morphological and systematic aspects of the problem.

It may be possible to illustrate the subject matter of the paper by actual specimens, diagrams, maps and tables at the time of the Science Congress.

(iv) Gymnosperms

23. Occurrence of Abnormal Pinnae in *Cycas circinalis* Eich.

(Miss) ANNIE THOMAS, Annamalainagar.

Observations are based on *Cycas circinalis* Eich. growing in University Botanic Garden. Abnormality was found in 127 leaves out of 312 studied and this was of an order of 36%.

The abnormality consists in the pinnae becoming very much leathery and smaller in size of obovate or of obtuse shape with retuse tips. Size difference between the abnormal and normal pinnae has been of the order of 100%. The abnormal pinnae are darker green in colour as compared to the normal ones.

The abnormal pinnae exhibit the following anatomical differences as compared to the normal ones.

- (a) Epidermis is more strongly cutinized
- (b) Hypodermis is three layered (only one layered in normal)
- (c) Palisade cells are about double the length as compared to the normal
- (d) A broad chlorenchymatous tissue surrounds the vascular bundle, this tissue being absent in the normal pinnae.
- (e) There is a markedly profuse development of transfusion tissue round the vascular bundle extending into the lamina.

The cause of the occurrence of abnormal pinnae is yet enigmatic and is under investigation.

24. Variability in the Tracheary Pitting of *Cedrus deodara* Loud.

(Miss) C. P. GODAVARI, Annamalainagar.

1. The lacerated margin of the torus of *Cedrus* has hitherto been considered to be a constant diagnostic feature.

2. This feature has been given undue importance to such an extent that some authors made extensive use of this character in the identification of the wood of *Cedrus* both living and fossil.

3. This character of the torus is conspicuously absent in the Nilgiri specimens and present in the Himalayan ones.

4. My observation namely the absence of the lacerated margin of the torus shows that the genus is highly variable in its wood structure and this view is well supported by Bailey who also points out the extreme variability of the wood of *Cedrus*.

5. In the absence of the lacerated margin of the torus, the medullary ray-cells with heavily pitted walls on all sides and many pits pointed towards the intercellular spaces can be considered to be the most important diagnostic feature.

6. The presence of poorly developed resin parenchyma and its restriction strictly to the late wood is also an almost equally important character in the identification of the word of *Cedrus*.

(v) Angiosperms (Systematics)

25. Fibre Yielding Weeds of Bombay and Its Suburbs. I. *Malachra capitata* Linn.

B. S. NAVALKAR, Visnagar (N.G.) and S. M. BETRABET, Bangalore.

While studying the physical and chemical properties of bast fibres, it was thought fit to pay attention to the plants yielding fibre other than jute and similar plants. The present investigations were made with a view to find out the plants, available in Bombay, that could be used as substitute for jute, as an acute shortage of jute was felt after the Indian Partition in 1947.

It was found from observations and phytosociological study that innumerable hereto neglected plants, especially belonging to cohort Malvales, are growing in abundance on waste lands of Bombay during monsoon. *Malachra capitata* Linn., a very common weed, has been taken for the investigation because of its adaptability to drought condition and prolific growth. It has high fibre content (11%).

fine colour and lustre, and compares well with white jute of commerce. It has long strands, long ultimate cells (2.0 mm.), L/D ratio is high (128), and useful for spinning. Its intrinsic strength is low (2.123) and percentage elongation at break is high (4.29) as compared to jute (3.72). It closely resembles in almost all chemical properties to Tossa jute. The fibres can be given a trial as jute substitute or can be mixed up with jute in large proportion. As it grows abundantly on waste lands, its cultivation will not displace any food or commercial crop.

Schopper's tester was used to find out the intrinsic strength and elongation break.

26. On the Fresh-water Swamp Vegetation of Uthangal (South Arcot District).

D. KASINATHAN, Annamalaiagar.

A study has been made of the Fresh-water Swamp forest vegetation of Uthangal, a village due south-west of the famous Lignite Mines of Neiveli. The area of this forest is over 17 acres and the marshy situation is produced by a number of perennial artesian wells which have existed here since time immemorial. The out-put of water from this area is so great that it commands all round it centrifugally, paddy cultivation of about 900 acres.

This swamp forest is remarkable in the fact that it represents plexus of reed-swamp and bush-swamp over-topped by tall trees growing to heights of about 60 to 80 feet.

The vegetation, therefore, of this fresh-water swamp may be graded in storeys : The first storey (tier) is constituted of tall trees like *Mangifera indica* Linn., *Bassia latifolia* Linn., *Eugenia jambolana*, Lam., *Ficus bengalensis* Linn. and it is curious to note that although they are mesophytic trees they have got adapted to the helophytic situations; the second storey is constituted of a gregarious and dominant growth of thick stemmed and very divergently branched specimens of *Pandanus*; the third storey is constituted of regular helophytes like *Typha angustata*, B. & CH., *Cyperus rotundus*, Linn., *Scirpus articulatus* Linn., *Polygonum glabrum* Willd., *Lippia nodiflora* Michx., *Wedelia calendulacea* Less., etc. and here and there sporadically, there are deep pockets of water in which abound the hydrophytic plants like, *Ottelia alismoides* Pers., *Aponogeton monostachyon* Linn. and *Marselia* sp. The floor storey is of immense interest because the substratum is predominantly a thick mat of dead debris of *Pandanus* and other plants which recall something of the floating island of Khajiar.

So, this whole forest in three tiers is a very shady place full of humidity; under these situations we find gregarious growth of Cryptogamic plants like, *Acrostichum aureum* Linn., *Nephrodium elatum* Baker., *Nephrolepis tuberosa* Hook and *Ceratopteris thalictroides* Linn. Two species of *Polyporus* grow quite luxuriantly on the dead tree trunks. Such a kind of vegetation is unknown either on the plains or on the hill stations of South India. Its occurrence, however, in contiguity with the Neiveli Lignite Mines, raises the issue whether this swamp forest is not the last remnant of a very extensive forest which existed in the days gone by and which now lies preserved as Lignite about 200 feet below the present earth-crust.

27. The Hydrophytes of Cuttack.

H. PATTNAIK AND N. K. CHYAU PATNAIK, Cuttack.

The Botanical survey of Orissa has recently been started with a view to collecting all the plants of Orissa for the study of systematic botany as well as for the discovery of rare, economical and medicinal plants. A preliminary work has

been done to find out the hydrophytes of the city of Cuttack. It has been found out that the number of aquatic monocots are more than the aquatic dicots. Families like *Hydrocharitaceae*, *Cyperaceae*, *Gramineae*, and *Pontederiaceae* are dominating. Of the total population about 60% are free-floating showing their vegetative luxuriance mostly in rainy season, coming to flower as the ditches and ponds dry up at the late autumn.

28. A Preliminary Survey of the Medicinal Plants of Agra.

K. C. BASU CHAUDHARY, Agra.

In a preliminary survey for the medicinal plants in the flora of Agra, the author has recorded 66 species belonging to 33 families of flowering plants. The plants in reference are systematically arranged after Bentham and Hooker. Latin names of each plant is followed by the name in the local language and parts of the plant employed in medicine are mentioned along with their actions.

(vi) Angiosperms (Morphology)

29. The Embryology of *Corchorus olitorius* Linn. and *C. capsularis* Linn.

P. K. BANSAL, Jaipur.

A reinvestigation of the embryology of *Corchorus olitorius* and *C. capsularis*, belonging to the family Tiliaceae, have shown certain features not reported by previous workers.

The anther wall comprises four cell layers—the epidermis, endothecium, a middle layer and the tapetum. Two middle layers are present in *C. capsularis*. The archesporium cuts off a parietal layer from which are derived the outer endothecium and the inner middle layer and tapetum. The tapetal cells are 2-3 nucleate in *C. olitorius* and 4-5 nucleate in *C. capsularis*. Tetrahedral, decussate as well as isobilateral pollen tetrads are formed as usual. Pollen grains are shed at the 2-celled stage.

The ovule is bitegmic, anatropous and crassinucellate. The micropyle is formed by the outer integument. The archesporium is hypodermal in origin and may be single-celled or two-celled. The embryo-sac is of the Normal 8-nucleate type. Starch grains are present in the embryo-sac. The antipodals degenerate before fertilization.

In the two species of *Corchorus* the generative nucleus divides within the pollen grain before pollen tube formation while on the stigmatic surface, contrary to the observation of Rao (1952). The male gametes appear vermiform in shape. Fertilization is simultaneous and occurs 5 hours after pollination. The male gametes appear rounded at the time of fusion with the egg and the polar nuclei. The pollen tube persists in the embryo-sac for about 20 hours after fertilization. The primary endosperm nucleus divides approximately 22 hours after fertilization. The endosperm is of the Nuclear type. Cell-wall formation occurs at the heart-shaped stage of the embryo. Some hypertrophied endosperm nuclei which appear to have resulted from fusion of several nuclei are noticed in the lower part of the embryo-sac.

The first division of the zygote is transverse and occurs after 50-60 endosperm nuclei have been formed. Both the apical and the basal cells of the two-celled proembryo contribute to the development of the embryo. The suspensor is 2-3 celled.

The seed coat comprises both the epidermal layers of the inner integument, the outer one forming the 'Palisade' layer. The outer integument does not survive but persists as a papery layer in the mature seed.

30. The Contribution to the Life-History of *Alysicarpus monilifer* Dc.

D. KAMALA, Hyderabad-Deccan.

The development of the microsporangium, megasporangium, female gametophyte, fertilisation, endosperm, embryo and seed of *Alysicarpus monilifer* has been studied.

A single layer of hypodermal cells forms the primary archesporium in each anther lobe. The anther consists of an epidermis, four wall layers, secretory uninucleate tapetum and one or two rows of spore mother cells. Fibrous endothecium is differentiated before dehiscence. Pollen mother cells undergo two meiotic divisions, tetrahedral and bilateral tetrads are formed. Cytokinesis takes place by furrowing. The pollen is shed at two-nucleate stage. The exine is smooth and possesses three germ pores. The ovule is crassinucellate, bitegmie campylotropous. The primary archesporial cell by one periclinal division gives rise to parietal cell and a megaspore mother cell. A linear tetrad of megaspores is formed after a meiotic division in megaspore mother cell. Three successive mitotic divisions without wall formation in functional chalazal megaspore result in eight nucleate embryo-sac of polygonum type. Hypostase is present. Micropyle ziz-zag.

Fertilization is porogamous. Pollen tube contains one vegetative and two generative cells and traverses through the inter-cellular spaces of the stylar tissue and the nucellus. It discharges its contents into a synergid which breaks at its apex and the contents flow to the vicinity of the egg. Syngamy takes longer time than triple fusion. The pollen tube is persistent. Endosperm development follows the nuclear type. Cell-formation starts at the micropylar end of the embryo-sac and extends to chalazal end. At the chalazal end the endosperm remains free nuclear for a long time even after the appearance of cotyledons and has a tubular form which acts as a haustorium. The terminal cell *Ca* and basal cell *Cb* of the two-celled proembryo are formed after the first division of the oospore. The cell *Ca* contributes to the formation of the embryo proper and the cell *Cb* forms only the large suspensor. A wedge-shaped epiphysal initial is differentiated from the cell *a* that is the daughter cell of *Ca*. This ultimately forms the stem apex. The sister cell of the epiphysis with the two daughter cells of the cell *b* by undergoing further divisions form two tiers of cells. The tier *pc*, below the epiphysis gives rise to cotyledons and the tier *pc'*, which is above the suspensor gives rise to hypocotyledonary region and hypophysis of the embryo. Thus the embryo development follows the trifolium variation of the onagrad type. The mature seed is nonendospermic and the seed coat is formed by the outer integument.

31. A Contribution to the Embryology of Some Members of the Family Cucurbitaceae.

DALBIR SINGH, Agra.

The following members of the Cucurbitaceae are investigated: *Cephalandra indica* Naud.; *Citrullus colocynthis* Schrad., *C. vulgaris* Schrad. (thermaphrodite flowers), *C. vulgaris* var. *fistulosus* Stocks.; *Lagenaria vulgaris* Ser.; *Luffa aegyptiaca* Mill.; *Melothria maderaspatana* Linn.; *Momordica charantia* Linn., *M. cochinchinensis* Spreng.; *Trichosanthes dioica* Roxb. and *T. anguina* Linn.

The wall of the anther consists of an epidermis, and endothecium, two middle layers and a single layer of tapetum of which the endothecium develops the usual fibrous thickening while the epidermis and middle layers together with the tapetum degenerate at maturity. The microspore tetrads formed are of tetrahedral, isobilateral and decussate types. The pollen grains are shed at two-celled stage in

some members like *Momordica* sps. and at three-celled stage in others like *Lagenaria*, *Melothria* and *Trichosanthes*. In most cases the pollen grain germination shows a monosiphonous condition while a considerable number of them also show a polysiphonous condition.

The ovules are bitegmic, crassinucellate and anatropous. The nucellar tip is beak-shaped which travels in the micropylar canal to various levels and in *Lagenaria vulgaris* it is found to have protruded above the level of integuments.

Megaspore mother cell forms either a linear tetrad of megaspores or a row of three cells in which the lower two are megaspores. It is the chalazal megaspore which usually functions. Simultaneous development of micropylar and chalazal megaspores is, however, observed in *Citrullus colocynthis*. The embryo sac is of the Polygonum type. In *C. vulgaris*, in some embryo sacs, one or two antipodal cells persist even after fertilisation; they enlarge considerably and acquire the haustorial function.

32. Life History of *Viola tricolor* L.

DALBIR SINGH, Agra.

Viola tricolor L., a common garden winter annual, possesses bitegmic, crassinucellate and anatropous ovules. The megaspores are arranged in a linear tetrad generally; less frequently in a row of three cells of which the upper is the undivided dyad cell. The chalazal megaspore always functions. The embryo sac which develops after the Polygonum type mostly has normal orientation. In one case, however, the egg was observed at the chalazal end and the polars were present near it. This embryo sac showed no antipodal cells and no synergids.

Double fertilisation is observed. The pollen tube enters the embryo sac through the micropyle after crushing one of the synergids. The sperms prior to fusion show distinct nucleoli and nuclear membrane.

The endosperm development is free nuclear.

Development of the embryo, observed in precise detail, shows that the first division of the zygote is transverse. The following division in the apical cell is vertical and in the basal cell transverse resulting in an inverted T-shaped tetrad. The subsequent divisions confirm to the Asterad type of development. Some cases of embryo development, however, show a marked variation. In these cases both the cells of a bicelled proembryo divide transversely and subsequently shows a Chenopodiad type of development. The mature embryo is straight and has two cotyledons.

Both the integuments consist of two layers of cells at the megaspore mother cell stage. Later on, however, they become three layered and both of them take part in the formation of seed coat. The outermost layer of the seed, formed by the outer epidermis of the outer integument, consists of mixed patches of two types of cells (i) simple thin-walled palisade cells, (ii) palisade-like cells with reticulate thickenings. Rest of the cells are greatly pressed in the mature seed coat.

The hypostase develops at two places in the ovule (i) in the nucellus directly below the embryo sac, (ii) slightly below it at the level of the integuments in the chalazal region. The cells of the nucellus between the two hypostases are mostly crushed, only a few layers persist. The chalazal cells above the lower hypostase become thick-walled and join the layer of the sclerenchyma in the seed coat. These thick-walled cells are arranged in three or more layers in a mature seed.

The endosperm as well as the perisperm are present in the mature seed.

A single vascular bundle entering the chalaza bifurcates and fans out to form a cup.

The mature seed is top shaped and arillate. The aril is formed by the proliferation of the micropylar cells of the outer epidermis of seed coat.

33. The Embryology of *Clematis gouriana* Roxb.

R. L. N. SASTRI, Waltair.

The present paper describes the structure and development of pollen, embryo sac and endosperm in *Clematis gouriana*.

The anther wall is five layered of which the innermost forms a tapetum of secretory type. The hypodermal wall layer develops into the fibrous endothecium. Division of pollen mother cells is simultaneous and cytokinesis takes place by furrowing. Pollen tetrads are tetrahedral or isobilateral. Pollen grains are two celled at the time of shedding.

There are four or five ovules in a carpel, of which only one reaches maturity while the others degenerate. The remnants of the degenerating ovules are found till a very late stage in the development of the fruit. Embryo sac development proceeds normally in the degenerating ovules but their nucellus becomes crushed at the eight nucleate embryo sac stage, only the nucellar epidermis remaining. The growth of the integument is arrested at a very early stage in the degenerating ovules.

The functional ovule is unitegmic, anatropous and crassinucellate. A single hypodermal archesporial cell is formed, which functions directly as the megaspore mother cell without cutting off a primary parietal cell. The megaspore mother cell forms a linear tetrad of megaspores of which the chalazal one is functional. The embryo sac is of the Polygonum type. The nucellar epidermis undergoes a periclinal division and becomes two layered in the apical region at the eight nucleate embryo sac stage. The antipodals undergo secondary increase in number and persist till a large number of endosperm nuclei are formed. They become narrow and elongated and are very conspicuous in the mature embryo sac. After a few endosperm nuclei are formed a postament is formed, in which the antipodals are lodged. The synergids have hooks and filiform apparatus.

Endosperm is of the nuclear type. Wall formation starts from the periphery at about the time the embryo becomes globular.

34. The Gametophytes of *Mahonia leschenaultii* Takeda (*Berberis leschenaultii* Wall).

R. L. N. SASTRI, Waltair.

The wall of the mature anther consists of five layers of which the innermost functions as tapetum of secretory type, which shows a tendency towards the fusion of tapetal protoplasts. The tapetal cells have initially two nuclei each but the latter increase to 4-8 in number due to mitotic divisions at about the time the pollen mother cells are in Metaphase I. The tapetal cells become large in size and are conspicuous with big nuclei and vacuolated cytoplasm. The hypodermal wall layer becomes the fibrous endothecium. Cytokinesis is by cell plate formation and division of pollen mother cells is successive. Pollen tetrads are isobilateral or tetrahedral. The mature pollen grains are two celled.

There are 4 or 5 ovules in each carpel, all of which reach maturity. The ovule is bitegmic, anatropous and crassinucellate. The micropyle is formed by both the integuments and is zigzag. A single hypodermal archesporial cell is differentiated in the young ovule; it cuts off a parietal cell which by a series of periclinal divisions gives rise to 6-8 layers of parietal tissue at the mature embryo sac stage. In addition to these, the cells of the nucellar epidermis undergo periclinal divisions in the apical region and form about 4 layers of cells which show dense cytoplasm in the mature ovule. The megaspore mother cell forms a linear tetrad of megaspores of which the chalazal one functions and gives rise to an embryo sac of the

Polygonum type. The synergids are conspicuous and persistent and show filiform apparatus. The antipodals are persistent and conspicuous with large and hypertrophied nuclei and vacuolated cytoplasm.

Mahonia leschenaultii shows many embryological features in common with *Berberis nepalensis* studied by Johri (1935). However, the differences between the two are significant enough not to justify the treatment of the former as a variety of the latter as has been done by Hooker (1897).

35. Cytological and Embryological Studies in *Daemia extensa* Br.

INDU SEKHAR BISWAS, Calcutta.

1. The diploid number of chromosomes as determined from the root tip cells is twenty-two, of which one pair is long and shows submedian primary constriction and secondary constriction in the longer arm. Five pairs are medium sized, of which two pairs are with subterminal, one with submedian, one with median primary constriction, and the other with submedian primary constriction with satellites in the shorter arm. Of the remaining five pairs of short chromosome, three have median and two submedian primary constrictions. The shortest among them has satellites in the longer arm.

2. Meiosis is normal though early disjunction of the bivalents have been observed. Eleven bivalents have been noted at diakinesis and metaphase I.

3. Pollen formation is of the successive type and results in a linear tetrad of microspores.

4. Spermatogenesis takes place within the pollen grains, which are tri-nucleate. The male gametes have one end attenuated and drawn out.

5. In the development of the pollinium the glandular cells of the stigmatic ridge produce a secretion, which becomes cartilagenous to form the bi-hooked corpusculum at the centre. Lateral prolongations develop from this on both sides. The tapetal secretion, which envelops the pollen grain appears to be of a similar nature to that given out by the glandular stigmatic cells. On disorganisation of the anther wall the tapetal secretion enveloping the pollen mass extends outwards at the stomial regions and unites with the lateral processes of the corpusculum to form the caudicle.

6. The ovules are anatropous, tenuinucellate, unitegmic. The archesporial cell is hypodermal in origin and directly gives rise to the megaspore mother cell. A linear tetrad of megaspores is formed of which the chalazal functions to give rise to an 8-nucleate embryo sac. The embryo sac is of the "Polygonum type" and shows the presence of starch grains in the mature condition. Fertilisation is porogamous. Syngamy and triple fusion have been observed and the triploid nature of the endosperm cells has been determined. The endosperm passes through an early free nuclear stage before becoming cellular. Embryo development corresponds to the *Linum* variation of the Solanad type.

36. Embryological Studies in *Palmae*—IV.

C. VENKATA RAO, Waltair.

In this paper, the embryology of *Licuala grandis* H. Wendel, *L. peltata* Roxb., *L. spinosa* Wurumb., *Livistona chinensis* R. Br. and *L. rotundifolia* Mart. is described.

The mature anther wall consists of a heavily cutinised epidermis, a layer of fibrous endothecium, 1-2 median layers and 1-2 layers of tapetum which is of secretory type. The tapetal cells become 2-nucleate. The sporogenous tissue shows a secondary increase and gives rise to tetrahedral and bilateral tetrads of

pollen grains. Cytokinesis is by simultaneous cell plate formation. Mature pollen grains are ellipsoidal or spherical, 2-celled, monocolpate, and aporate. The generative cell is crescent shaped. Sterility is common.

The ovules are anatropous in *Licuala* species and *Livistona chinensis* and nearly orthotropous in *L. rotundifolia*. They are bitegmic and crassinucellate. The massive outer integument is traversed by vascular bundles. The micropyle is formed by both the integuments; it is straight in *L. rotundifolia* and zigzag in the rest. In *L. rotundifolia* the nucellar cells function as tapetum; in others a well defined endothelium is organised. Species of *Licuala* show postament formation. In *Livistona* sp. there is a well developed funicular obturator of radially elongated glandular cells.

The archesporium of the ovule consists of a single hypodermal cell which cuts off the parietal cell. The megaspore mother cell is elongated and megaspore tetrads are linear or T-shaped. Embryo sac develops according to the *Normal-type*. The polar nuclei fuse before fertilisation and the antipodals last till the time of fertilisation.

Fertilisation is porogamous. Endosperm is of nuclear type and becomes cellular by simultaneous cell plate formation. The endosperm cells store hemicellulose in their walls and starch and proteins in their lumens. In *L. rotundifolia* the chalaza grows into a columnar structure in the seed. In *L. grandis* the chalaza becomes hump-like and develops warty protuberances which make the endosperm ruminate. The embryo consists of a small primary axis enveloped by a massive cotyledon. During germination, the cotyledon forms an elongated tube in *L. rotundifolia*.

37. Embryological Studies in Palmae—V.

C. VENKATA RAO, Waltair.

This paper deals with the embryology of *Trachycarpus* sp., *Sabal adansoni* Guers., *S. blackburniana* Glazeb., *S. palmetto* Lodd., and *Washingtonia* sp.

The floral organs in *S. palmetto* arises in acropetal sequence.

The anther tapetum is of secretory type and consists of 2-nucleate cells. In *S. palmetto* the inner walls of the tapetal cells become cutinised. Dehiscence of the anther is longitudinal and is brought about by fibrous endothecium at a well defined stomium. Microspore tetrads are tetrahedral or bilateral and cytokinesis is by simultaneous cell plate formation. Mature pollen grains are 2-celled, monocolpate and aporate.

Ovules are anatropous in *Trachycarpus* and *Washingtonia* and hemianatropous in *Sabal* species. They are crassinucellate and bitegmic. The micropyle is zigzag in *Trachycarpus* and straight and formed by only the inner integument in *Washingtonia* and *Sabal* species. The inner epidermis of the inner integument forms the endothelium in *Washingtonia* and *Trachycarpus* sp. Species of *Sabal* show a well developed funicular obturator. A postament is developed in the ovules of *Washingtonia*.

The single archesporial cell of the ovule cuts off the primary parietal cell and the megaspore mother cell becomes deep seated, elongated and tapering. The megaspore tetrads are linear or T-shaped and the lowest megaspore forms the embryo sac according to the *Normal-type*. Fertilisation is porogamous. Endosperm is of nuclear type. The endosperm cells of mature seed show thick pitted walls which store hemicellulose and starch and proteins in their lumens. Though the ovary consists of three uniovulate carpels, the fruit is simple and contains a single seed. The fruit wall in *Sabal* develops a single zone of peripheral sclerenchyma. During germination of seed, the cotyledon forms an elongated tube. The radicle forms a pretty long tap root which in due course becomes arrested and replaced by adventitious roots.

38. Embryological Studies in Palmae—VI.

C. VENKATA RAO, Waltair.

Fertilisation, development of the endosperm, embryo, seed and fruit and germination are described in *Actinophloeus macarthurii* Becc. belonging to the tribe Arecineae.

The fertilisable ovary shows a single pendulous anatropous ovule with a long straight micropyle formed by both integuments. The secondary endosperm nucleus stands close to the egg apparatus and the antipodals are located in the postament attached to the integument about half way in the embryo sac.

Fertilisation is porogamous and the passage of pollen tubes is facilitated by the glandular cells of the transmitting tissue, locular extension and funicle. The endosperm becomes cellular by a process of vacuolation at the first instance; later the endosperm around the central vacuole of the seed becomes cellular by simultaneous cell plate formation. The mature seed shows a peripheral zone of regularly arranged cells and a central one of cells irregular in shape and distribution. The endosperm is not ruminant; its cells are thick walled due to storage of hemicellulose. The seed coat is formed by the outer integument and is 15-20 cells thick; the inner half consists of tannin filled cells and the outer half is traversed by vascular bundles.

The embryo develops according to Onagrad type. *cb* forms the suspensor and *ca* contributes to the formation of the embryo proper. Of the quadrants formed by the latter one functions as the epiphyseal cell and gives rise to the plumule which shows several primordia of vegetative and scale leaves. The remaining 3 quadrants form the massive cotyledon and root tip.

The fruit is a drupe. The fleshy epicarp which contains masses of stone cells and the mucilaginous mesocarp separate out from the stone. This consists of the deeply lobed seed, fused with the endocarp which contains several fibrovascular bundles, and the persistent stigma. During germination the inner part of cotyledon forms a haustorium and absorbs the food stored in endosperm, and the outer part forms short tube. The tap root becomes arrested and replaced by adventitious roots.

39. A Contribution to the Life-History of *Oroxylum indicum* Vent.

JAGADANANDA GHATAK, Calcutta.

The paper gives an account of the cytology and embryology of *Oroxylum indicum*.

The 2n number of chromosomes has been found to be 28. The morphology of the somatic chromosomes has been studied.

The development of the sporogenous cells, the endothelial layers and the tapetal layer has been followed. Meiosis shows no unusual feature. 14 bivalent chromosomes occur and pollen formation is of the simultaneous type. The pollen grains are binucleate, spheroidal-prolate, tricolpate with exine thicker than the intine.

The ovules are unitegmic, tenuinucellate and mostly anatropous. The archesporial cell is hypodermal in origin and functions directly as the megaspore mother cell. Embryo-sac development is of the *Polygonum* type.

Fertilization is porogamous. Stages of syngamy and triple fusion have been found.

The endosperm is cellular and corresponds to the *Catalpa* type with slight variations. The four-celled chalazal haustorium is functional.

The development of the embryo is of the *Capsella* type with secondary variations.

The development of the wings of the seeds has been described.

40. Some Observations on the Development of Endosperm in the Leguminosae.

B. M. JOHRI and SUDHA GARG, Delhi.

In the Leguminosae, the endosperm shows a characteristic chalazal haustorium which mostly remains free nuclear. Several members have already been investigated by Narasimhachar, Dnyausagar, Pantulu and Anantaswamy Rau. In some cases the haustoria had been overlooked in the first instance but were recorded on reinvestigation. We have examined *Alhagi camelorum* Fish., *Arachis hypogaea* Linn., *Desmodium floribundum* G. Don., *Tephrosia villosa* Pers., *Cassia sophora* Linn., *Delonix regia* Rafin., *Acacia senegal* Willd., *Mimosa pudica* Linn. and a few other species.

The endosperm is of the Nuclear type. Centripetal walls are initiated at the micropylar end and progress towards the chalaza. Usually wall formation starts prior to the globular stage of the proembryo but in *Arachis hypogaea* it is delayed until the cotyledons have well advanced. Cellular condition is limited to the upper part of the embryo sac, which forms the 'endosperm proper'. The haustorium persists in the free nuclear condition.

The haustorium is appreciably elongated in *Delonix regia* (1862 μ), *Cassia sophora* and *Alhagi camelorum* (1140 μ); it is of intermediate length in *Acacia senegal* (988 μ), *Desmodium floribundum* (798 μ), *Tephrosia villosa* and *Mimosa pudica* (380 μ); and is rather short and inconspicuous in *Arachis hypogaea* (95 μ).

The haustorium attains maximum size when the proembryo is globular, and sometimes at the heart-shaped stage of the embryo. Its nuclei vary from 24-152 microns in diameter, and occasionally they aggregate in groups of 3-5. The cells of the endosperm proper are usually uninucleate but multinucleate condition has been observed in *Tephrosia villosa*.

The progress of the embryo beyond the heart-shaped stage is accompanied by expansion of the endosperm proper, and shrinkage and degeneration of the haustorium. During maturation of the seed, the embryo consumes practically the whole of the endosperm.

The present study has been undertaken to ascertain if the origin, development and structure of the haustorium bears any taxonomic significance.

41. A Contribution to the Embryology of *Elytraria acaulis* Lindau.

B. M. JOHRI and HARDEV SINGH, Delhi.

The embryological studies on the family Acanthaceae are far from adequate. The most extensive work is that of Mauritzon.

In *Elytraria acaulis*, the anther wall consists of the papillate, starchy epidermis, fibrous endothecium, an ephemeral middle layer, and the multi-nucleate glandular tapetum. The pollen is shed at the 2-celled stage. The development of the embryo sac is of the Polygonum type as also reported by Pathak and Ambegaokar. The polars fuse only after the entry of the pollen tube; rarely one of the antipodal cells may divide with or without the accompaniment of wall formation. The embryo sac is curved, contains abundant starch, and at the chalazal end it extends as far as the ovular hypodermis.

The endosperm is Cellular. The first division of the primary endosperm nucleus cuts off a chalazal haustorium which becomes 4-nucleate and degenerates early. The next division is in the upper cell giving rise to the central chamber and the micropylar haustorium. The latter penetrates into the integument, persists till a late stage and shows 2 or 3 large nuclei. The central endosperm chamber did not show any free nuclear divisions and even when it contained only 2 nuclei, they were separated by a wall. Its subsequent development is very asymmetrical so that the micropylar and the chalazal haustoria are pushed to a

lateral position. A 'basal apparatus' is absent. Bulk of the endosperm is produced by the central chamber which becomes ruminated in the seed. The outer tangential wall of its epidermis is conspicuously thickened.

The first division of the zygote is transverse and the mature embryo is typically dicotyledonous. During maturation of the seed the embryo consumes the adjoining endosperm tissue.

Of the 8-10 layers of the starchy integument, the flattened epidermis and remnants of some of the underlying layers persist in the testa. The furrows of the ruminated endosperm remain filled with the integumentary tissue. The endosperm as well as the embryo store fatty food reserve. The pericarp consists of 4-5 layers of thick-walled cells.

42. Development of Endosperm and Nucellar Polyembryony in *Aegle marmelos* Correa.

B. M. JOHRI and M. R. AHUJA, Delhi.

In 1936, Chakravorthy reported that "nucellar embryos are very rarely formed in *Aegle* and even then they seem to stop development at a very early stage. . . ." On the contrary, we find nucellar embryony to be quite common in *A. marmelos*.

There are nearly 200 ovules in an ovary but about 75 per cent contain degenerated gametophytes. In most of the remaining embryo sacs also the antipodal cells and the egg apparatus collapse and finally only the polars persist in a healthy condition. It is presumed that triple fusion occurs.

The endosperm is Nuclear. When approximately 256 nuclei have been produced, some of them aggregate at the chalazal end of the embryo sac. Centripetal wall formation is initiated at the micropylar end and progresses downwards. An interesting feature is the development of a chalazal haustorium which attains its maximum activity at the heart-shaped stage of the embryo and digests the surrounding tissue. Later on it shrinks, becomes coiled, and is ultimately absorbed.

While the embryo sac still shows free endosperm nuclei, some of the nucellar cells at the micropylar end, particularly those bordering the embryo sac, appear richly cytoplasmic. One or more of these 'plasma-rich cells' divide resulting in an embryonal mass which projects into the cavity of the embryo sac. As many as 3 such masses may develop concurrently. Eventually only one of them takes the lead and passes through the globular and heart-shaped stages. At maturity, a typical dicotyledonous embryo is produced.

Nucellar polyembryony is a regular feature in *Aegle marmelos*. While the possibility of a zygotic embryo cannot be completely ruled out, our preparations did not give any such evidence.

43. The Female Gametophyte of *Opuntia aurantiaca* Lindl.—A Reinvestigation.

R. N. CHOPRA, Delhi.

As yet only two cases of embryo sacs, other than monosporic, have been reported in the Cactaceae: one by d'Hubert (1896) in *Phyllocactus* sp. (*Adoxa* type) and the other by Archibald (1939) in *Opuntia aurantiaca* (*Allium* type). Of these, the former report has been criticised by Mauritson (1934) and P. Maheshwari (1946). The validity of the latter has also been questioned by P. Maheshwari (1950) and S. C. Maheshwari (1955).

A reinvestigation of *O. aurantiaca* was undertaken in order to trace the development of the embryo sac. The material was kindly supplied by Miss E. E. A. Archibald (S. Africa), to whom the author is very grateful. In her study (Archibald, 1939) of this species she writes: "The megaspore mother cell divides giving

the two-celled dyad stage, and a further division of the lower dyad cell gives a row of three cells, the uppermost being an undivided dyad cell. It is this uppermost or micropylar cell which forms the eight nucleate bisporic embryo sac."

The present work has revealed that in most cases the upper dyad cell fails to divide and a row of three cells is formed, but normal tetrads of megaspores are also quite common. It is invariably the chalazal megaspore which develops into the embryo sac, while the upper 3 megaspores or one megaspore and the undivided dyad cell promptly degenerate. Thus in *O. aurantiaca* also, as in other Cactaceae, the embryo sac is of the Polygonum type.

44. The Morphology and Embryology of *Tolypanthus* Bl.

S. N. DIXIT, Delhi.

So far the genus *Tolypanthus* (family Loranthaceae, sub-family Loranthoideae) has not been studied embryologically. This paper deals with some aspects of morphology and embryology of *T. lagenifer* (Wight) Van Tiegh. and *T. involucratus* (Roxb.) Van Tiegh. The material of the former was collected from Khandala (Bombay) while that of the latter was obtained from Gauhati (Assam) through the courtesy of Mr. V. Raghavan to whom the author is very grateful.

The inflorescence is characterized by the presence of a conspicuous involucre. It is bell-shaped in *T. lagenifer* and encloses 5 sub-sessile, pentamerous flowers; while in *T. involucratus* it comprises 4 large, foliaceous bracts, each bearing a single flower.

The development of the female gametophyte is similar to that of *Amyema*. As many as 12 embryo sacs elongate simultaneously and their tips, carrying the egg apparatus and the upper polar nucleus, come to lie in the stylar canal. The lower polar nucleus and the antipodal cells are formed in the basal part of the embryo sacs which are situated in the ovary. In *T. lagenifer* the apex of the longest embryo sac reaches up to half the length of the 35 mm. long style, while in *T. involucratus* the maximum length attained is three-fourths the height of the 15-17 mm. long style.

A composite endosperm, biseriata proembryo and a pseudo-monocotyledonous embryo (cotyledons are fused except in the region of plumule) are formed in the usual way. The swollen radicular end of the embryo, which is really hypocotyledonary in nature remains outside the endosperm and does not show any protuberances.

Germinating seeds of *T. lagenifer* were observed on the stem of *Randia brandissi*. The seedlings stick to the bark of the host with the help of the sticky viscid layer. Some seeds were also germinating on the leaves of the host plant or even on the ground. However, they perish early due to lack of nutrition.

At the time of germination, the radicular end of the embryo bends towards the host. As it comes in contact with the bark, it swells and forms flattened hold-fast. Soon after, the haustorium arises from this hold-fast and enters the host tissues. The host-parasite relationship is under investigation.

45. The Embryology of *Leptomeria* R. Br.

MANASI GHOSH, Delhi.

The sub-sessile flowers of *Leptomeria* are borne in a raceme.

The anther wall comprises the epidermis, fibrous endothecium, a single ephemeral middle layer, and the glandular tapetum. Reduction divisions of the microspore mother cells are simultaneous, resulting in decussate and tetrahedral

tetrads. The pollen grains are circular with 3 germ pores and are shed at the 3-celled stage.

The inferior ovary is 5-chambered at the base but only unilocular above. It has 5 ovules borne on a central placental column. In *L. cunninghamii* they are pendulous with the micropyle pointing towards the base of the ovary, whereas in *L. acida* they are anatropous with the micropyle directed towards the stylar canal. The integument and the nucellus cannot be clearly distinguished from each other.

There is a multicelled archesporium but only one cell functions as the megaspore mother cell. After Meiosis I, due to failure of division of the upper dyad cell, a triad is formed in *L. cunninghamii* but in *L. acida* both linear and T-shaped tetrads have been observed. The chalazal megaspore functions and produces a normal 8-nucleate embryo sac, which is gorged with starch grains. The antipodal cells degenerate early. In *L. cunninghamii*, the micropylar end of the sac grows beyond the ovule (carrying the egg apparatus with it), bends towards the style and elongates along the surface of the ovule. Later on a protuberance arises laterally, just above the antipodal cells. It grows through the ovule, invades the placental column and the embryo sac acquires the shape of an inverted N. The chalazal arm is much longer than the micropylar and is haustorial in function.

The first division of the primary endosperm nucleus is followed by a curved wall forming a micropylar and a chalazal chamber. The nucleus of the latter does not divide any further but becomes hypertrophied and moves down to the middle of the haustorium. The nuclear division in the micropylar chamber is not immediately followed by a wall. One of the daughter nuclei moves up while the other remains close to the first wall and gathers cytoplasm around it. Finally, a wall is laid down close to the first one. The bulk of the endosperm is formed by the activity of the uppermost cell and it gradually consumes the ovular tissue, the placental column and the parenchymatous endocarp so that the endosperm comes to lie in direct contact with the sclerotic mesocarp.

The first division of the zygote is transverse and is followed by a longitudinal division of the terminal cell. Further divisions result in a globular proembryo. The mature embryo is dicotyledonous, sometimes tricotyledonous.

46. The Occurrence of 'embryo sacs' in the Microsporangia of *Leptomeria billardieri* R. Br.

MANASI GHOSH, Delhi.

The embryo sac-like giant pollen grains with a construction similar to that of a true embryo sac were first observed by Nemec (1898) in the petaloid anthers of *Hyacinthus orientalis*. Since then the same phenomenon has been observed by other workers in different varieties of this species and in *Ornithogalum nutans* (Geitler, 1941).

In *Leptomeria billardieri*, a member of the family Santalaceae, the microspore mother cells have shown a most unusual behaviour. While some of them enlarge and become vacuolated, others degenerate. After the first division, the daughter nuclei get separated by a large central vacuole. Two further divisions result in an 8-nucleate condition with 4 nuclei at either pole. The nuclei of one of the quartets arrange themselves like an egg apparatus and the upper polar nucleus, and those of the other as 3 antipodal cells and the lower polar nucleus. Thus the whole structure closely resembles an 8-nucleate embryo sac. The 2 polar nuclei move to the centre and lie adpressed to each other. The antipodal cells, due to unilateral growth of the 'embryo sac', usually get displaced to one side,

Such 'embryo sacs' contain abundant starch which continues to increase until finally degeneration sets in.

Some variations were also observed: (i) after the first division the daughter nuclei may lie close to each other; (ii) in a 4-nucleate 'embryo sac', all the nuclei were grouped in the centre; (iii) a 6-nucleate 'embryo sac' had the egg apparatus, 2 polar nuclei and a multinucleolate chalazal nucleus; (iv) in a fourth case, 5 nuclei were present in the centre and sixth one had migrated to one end of the sac.

To the best of my knowledge, so far there is no record of development of an 'embryo sac' directly from the microspore mother cell.

None of the flowers examined, showed formation of normal pollen grains. Whether these are formed at all, is under investigation.

47. A Contribution to the Life History of *Begonia picta* Smith.

MADHU LATA, Delhi.

The lack of adequate embryological data on the Begoniaceae and its obscure systematic position, prompted this study.

At maturity the wall of the anther comprises the epidermis with a spiny cuticle, fibrous endothecium, a single ephemeral middle layer, and a multinucleate glandular tapetum. The microspore mother cells undergo simultaneous reduction divisions forming tetrahedral, isobilateral and decussate tetrads. The pollen is shed at the 2-celled stage. The thick smooth exine shows 3 furrows with one germ pore in each.

Numerous anatropous, bitegmic and weakly crassi-nucellate ovules are borne on the bifurcated axile placentae. Both the integuments are 2-layered.

A single hypodermal archesporial cell differentiates in the young nucellus. It cuts off a small parietal cell which undergoes no periclinal divisions. Rarely it may enlarge and simulate a megaspore mother cell.

The enlarging gametophyte absorbs the whole nucellus except a few apical cells of the epidermis which form a cap-like epistase. A group of cells at the chalazal end differentiate into a hypostase. Later the inner integument is also absorbed leaving only an operculum-like structure at the apex. The outer layer of the outer integument is composed of greatly enlarged cells.

Both linear and T-shaped tetrads are formed. Frequently the upper dyad cell fails to divide resulting in a row of 3-cells. The chalazal megaspore functions. The mature embryo sac conforms to the *Polygonum* type.

The endosperm is Nuclear to begin with, wall formation results in a peripheral layer of endosperm cells which undergo anticlinal and periclinal divisions. In the mature seed only a single layer persists and contains fatty food reserve.

The embryogeny corresponds to the Crucifer type. The mature embryo is typically dicotyledonous and its cells contain oil globules.

The seed coat is one-layered and is formed by the epidermis of the outer integument. Its cells have greatly thickened inner and radial walls which are heavily pitted.

On embryological evidence the Begoniaceae seems to be closely allied to the Datisceae.

48. The Embryology of *Chrozophora rottleri* A. Juss.—A Reinvestigation.

R. N. KAPIL, Delhi.

Srivastava and Agarwal (1953) have recently reported the occurrence of Allium type of embryo sac in *Chrozophora rottleri*. Kapil (1955) has, however, shown

Polygonum type in *C. obliqua* and this is now confirmed in *C. rottleri*. Several other inaccuracies in Srivastava and Agarwal's account are summarised below.

In *C. rottleri*, the ovule is bitegminal, crassinucellar and hemianatropous. The well developed nucellar beak projects beyond the micropyle and comes in contact with the feebly developed, placental obturator. One to two hypodermal archesporial cells differentiate but only one functions. Due to repeated divisions of the parietal cell and the apical cells of the nucellar epidermis, the megaspore mother cell gets deeply embedded in the nucellus. It undergoes the usual meiotic divisions resulting in a linear row of 4 megaspores. The chalazal megaspore functions and produces a normal 8-nucleate embryo sac. Srivastava and Agarwal wrongly concluded that the development is bisporic.

Fertilization is porogamous. The primary endosperm nucleus divides earlier than the zygote and produces free nuclear endosperm. Centripetal wall formation sets in at the heart-shaped stage of the embryo. At first a single layer of cells is formed along the periphery of the embryo sac and due to their repeated divisions, resembling the activity of cambial cells, the entire embryo sac gets completely filled with cellular endosperm. It stores fatty food reserve. The mature seed is carunculate, and endospermic and encloses a massive dicotyledonous embryo.

The above observations clearly indicate that the ovules are not anatropous, the archesporial cell does not function directly as the megaspore mother cell, the embryo sac is not of the Allium type, and the endosperm does not remain nuclear throughout as stated by Srivastava and Agarwal.

49. Development of Embryo Sac and Endosperm in *Chrozophora prostrata* var. *parvifolia* Klotzsch ex Schweinf.

R. N. KAPIL, Delhi.

The present study on the development of embryo sac and endosperm in *Chrozophora prostrata* var. *parvifolia* was undertaken with a view to corroborate the earlier findings on *C. obliqua* and *C. rottleri* (Kapil, 1955). Like these two species, *C. prostrata* var. *parvifolia* has a tricarpellary, syncarpous gynaecium and each locule of the superior, trilocular ovary, encloses a solitary, bitegminal, crassinucellar, hemianatropous ovule, borne on an axile placenta. The outer integument is initiated earlier than the inner but the nucellus grows faster than both, elongates beyond the micropyle, formed by both the integuments, and starts curving towards the placenta. Subsequently it meets the obturator and gets closely appressed to it. A few cells, immediately below the embryo sac, differentiate into a thick-walled hypostase which stains densely.

The megaspore mother cell gets deeply buried due to the formation of a massive parietal tissue contributed by the primary parietal cell and the nucellar epidermis. The first meiotic division results in the formation of a dyad. Subsequently the lower cell divides to form two megaspores but the upper often fails to divide. Therefore, triads are much more common than tetrads. The chalazal megaspore functions and forms an 8-nucleate gametophyte with the normal organization.

Porogamous fertilization occurs and in one instance two pollen tubes had entered the same embryo sac. The endosperm is of the Nuclear type and the first few divisions of the primary endosperm nucleus are synchronous. Repeated divisions give rise to many free nuclei which get uniformly distributed in a peripheral layer of cytoplasm. This is followed by centripetal wall formation and eventually the endosperm becomes cellular throughout.

It may, therefore, be concluded that the development of embryo sac and endosperm in *C. prostrata* var. *parvifolia* is essentially similar to that of *C. obliqua* and *C. rottleri*.

50. A Contribution to the Life History of *Dipteracanthus patulus* Jacq.

VIMLA NEGI, Delhi.

The pentamerous sub-sessile flowers arise singly or in clusters of 2 to 3. In a few cases tetramerous condition was also observed. The anther wall is 4-layered. The tapetum is multinucleate and of glandular type. The reduction divisions are simultaneous, cytokinesis occurs by furrowing, and the tetrads are usually of decussate type. Mature pollen grains are 2-celled and full of starch.

The ovules are anatropous, unitegmic and tenuinucellate. The single-layered nucellus is completely absorbed by the time the 4-nucleate embryo sac is formed. The latter comes in direct contact with integument, but an endothelium is not organized. Usually there are 2 hypodermal archesporial cells but only one functions. A parietal cell is not cut off. Linear tetrads are common. Some abnormal "tetrads" were seen having supernumerary degenerating megaspores.

The development of the embryo sac is of the Normal type. The tip of the mature embryo sac extends into the micropyle while a 'caecum' is formed at the chalazal end. A caecum has not so far been reported in the Acanthaceae. Occasionally one of the synergids may persist and become hypertrophied. The pollen tube is persistent and its remnants are recognizable even in the mature seed.

The endosperm is of the Cellular type. It comprises a 2-nucleate micropylar haustorium, a 4-nucleate chalazal haustorium, and central chamber which becomes distinguishable into a cellular upper part and a free nuclear lower part. Occasionally the chalazal haustorium, which collapses after the differentiation of the cotyledons, may be 2- or 5-nucleate. The micropylar haustorium remains distinguishable even in the mature seed. During the maturation of the latter the free nuclear portion of the central chamber is absorbed so that only the cellular endosperm persists.

The first division of the zygote is transverse. Both the cells again divide transversely. The embryo proper arises from the derivatives of the terminal cell. In a few cases twin embryos were observed. The additional embryo seems to arise due to the segmentation and subsequent proliferation of some of the suspensor cells. The only other report of polyembryony in this family (Acanthaceae) is by Gigante (1929) in *Acanthus mollis*.

At the time of fertilisation the single massive integument consists of 15-20 layers of parenchymatous cells. About 10-15 inner layers are digested by the endosperm. All round the rim the outer epidermis develops characteristic hairs, with annular or spiral thickenings. Two to three hypodermal layers get compressed and only the next two layers take part in the formation of the seed coat. The funiculus forms a horn-like structure, the "Jaculator", which aids in seed dispersal.

51. The Endosperm, Embryo and Seed structure in the Lemnaceae.

SATISH C. MAHESHWARI, Delhi.

The systematic position of the family Lemnaceae has been the subject of continued controversy among systematists and the morphologists. Recently Lawalrée (1945, 1952) has suggested an alliance with the Helobiales on the basis of the occurrence of a Helobial endosperm in *Lemna minor*.

In an earlier paper (S. C. Maheshwari, 1954) I reported that the endosperm in *Wolffia microscopica* appeared to be cellular. Judging from Lawalrée's photographs of *Lemna minor*, I commented on the possibility of an error in his observations and suggested that here also the endosperm may be cellular instead of Helobial as reported by Lawalrée. Definite evidence has now been obtained that this is really so both in *Wolffia* and a local species of *Lemna*, *L. paucicostata*.

In *L. paucicostata*, the first division of the primary endosperm nucleus is followed by a transverse wall. The second division is also transverse so that a vertical row of 4 cells is formed. The next two divisions occur vertically, at right angles to each other, giving rise to 16 cells arranged in 4 tiers.

The fertilized embryo sac is much broader at the micropylar end and narrower at the chalazal end. Further development accentuates this asymmetry still further and while the cells at the micropylar end continue to expand, those at the lower end do not show any such activity. Moreover, after about 16-celled stage of the endosperm, divisions in the lower half are completely arrested and this part appears as an appendage of a caecum. The bulk of the endosperm is thus derived from the micropylar portion.

Soon after initiation of endosperm development the zygote also divides transversely. The development proceeds much as in *Wolffia*, resulting in a pyriform embryo with a lateral mound of tissue designated in the earlier publication as the 'stem tip' (S. C. Maheshwari, 1954). In reality this is the first frond ('erste Glieder' of Goebel, 1921) now confirmed by a study of seed germination. As in *Wolffia*, it is later displaced to an almost vertical position, remaining enclosed on one side by the suspensor and on the other by the rest of the embryo ('Kotyledonarscheide' of Goebel). Another notable thing about the first frond is the differentiation of the primordia of its daughter frond even at this embryonic stage.

During germination the seeds float up in water and the operculum is pushed off by the suspensor. The cotyledonary sheath undergoes considerable growth and expansion and as a result thereof a pouch-like chamber is formed. The suspensor forms the floor of this chamber and the recently grown cotyledonary sheath forms the roof. In between these structures emerges the first frond together with the rudiments of its daughter frond attached at the basal end.

It may be stated at the end, that the embryo sac development in the Helobiales is monosporic (excepting the families Alismaceae and Butomaceae), whereas in the Lemnaceae it is bisporic. The endosperm in the Helobiales is either Helobial or Nuclear, while in the Lemnaceae it is Cellular. Finally, the embryogeny is quite different in the two orders. It is clear therefore, that Lawalrée's assignment of the family Lemnaceae to the Helobiales cannot be accepted.

52. Endosperm and Embryo development in Some Acanthaceae.

H. Y. MOHAN RAM, Delhi.

The endosperm in the Acanthaceae has a peculiar mode of development. The only well illustrated account so far available is that of Mauritzon (1934) who studied several members of the family. The present paper deals with some observations made on *Barleria cristata*, *Peristrophe bicalyculata*, and *Adhatoda vasica*. The first two plants were not studied by Mauritzon and his work on the latter is rather inconclusive.

The mature embryo sac is 8-nucleate and is very narrow. The synergids and the antipodal cells are ephemeral and degenerate soon after fertilization, excepting in *Barleria* where the antipodal cells persist during the early stages of endosperm formation. The two polar nuclei move to the centre and fuse to form a secondary nucleus. The embryo sac enlarges enormously towards the chalazal end. The early stages in the development of the endosperm have been studied in *Barleria*. The first division of the endosperm nucleus is followed by a wall to form a smaller chalazal and a larger upper chamber. The latter by another transverse partition sets aside a micropylar chamber. The micropylar and the chalazal chambers develop into haustorial structures.

The micropylar haustorium usually remains binucleate, but at times it may contain 4-5 nuclei. In *Adhatoda* and *Peristrophe* it is very aggressive, thrusting its

way into the funiculus and coming into direct contact with the vascular strand. In *Barleria*, however, the micropylar haustorium is not so active and does not extend into the funicular region. The chalazal endosperm haustorium is 2-nucleate in all the three species. It remains in contact with the vascular strand and conveys nutrition to the endosperm and embryo. In *Adhatoda* the haustorium persists till the embryo has attained maturity. The nucleus of the central chamber undergoes rapid nuclear divisions and produces a mass of nuclei which do not become arranged peripherally around a large vacuole as reported by Mauritzon in *Ruellia* but lie in a mass surrounding the embryo. In *Barleria*, wall formation takes place earlier than in the other two genera, after about 32 nuclei have been formed. In the other two plants it is postponed till about 128-256-nuclei have been produced. The central chamber expands very quickly and consumes some for the surrounding integumentary cells. In *Adhatoda* and *Peristrophe* the central chamber becomes cellular towards the micropylar haustorium but remains coenocytic in the chalazal region which has been referred to as the "basal apparatus" by Mauritzon. There is nothing like a basal apparatus in *Barleria* as the central chamber becomes walled up completely.

The embryo follows a more or less similar course of development in all the three genera. The zygote divides by a transverse wall. Further divisions also occur in the same plane resulting in a 8-10 celled uniseriate pro-embryo which extends into the central chamber of the endosperm.

In two ovules of *Barleria* the embryo had markedly advanced in development but the endosperm nucleus was still undivided.

53. A contribution to the embryology of *Cyperus rotundus* Linn.

PUSHPA KHANNA, Jaipur.

The plant is a common weed in the rainy season. The flower comprises a mono-carpellary ovary and three stamens. The anthers are quadrilocular. The homogenous sporogenous tissue is surrounded by a well defined epidermis, an endothecium, a middle layer and tapetum. The cells of the tapetum contain dense cytoplasm with a single conspicuous nucleus. The tapetal cells degenerate when the pollen grains are uninucleate. The cells of the endothecium become cutinized. The middle layer degenerates at the tetrad stage. The microspore mother cells divide meiotically to form four microspore nuclei of which one becomes quite prominent while the other three remain smaller in size. Tanaka (1940, 41) has seen a plasma membrane separating the three smaller nuclei from the big nucleus. I have observed that a wall is formed by a distinct cleavage furrow. Similar walls are laid down separating the three non-functional nuclei which eventually disintegrate and the degenerated mass is seen lying closely appressed to the wall of the pollen grain. The microspore nucleus divides to form the vegetative and generative cells. The ovule is anatropous, bitegmatic and crassinucellate. On the funicular side, the outer integument is completely suppressed. As the ovule becomes anatropous, a swelling appears on the funiculus and it covers the micropyle giving rise to an obturator. The organised embryo-sac is monosporic and 8-nucleate.

The endosperm is of the nuclear type but becomes cellular at the globular stage of the embryo. In the beginning the cells of the endosperm are uni-nucleate but later 5-6 nuclei are seen in each cell. Some of the nuclei may fuse to form a large polyploid nucleus. The cells of the endosperm invest the embryo on all sides. They contain abundant starch.

The embryo development is of the Onagrad type. The seed coat consists both of the integuments which are 2-layered. At the globular stage of the embryo, the inner layer of the inner integument develops characteristic cuticular foldings and

the cells show tannin. A few cells of the nucellus also contain tannin in the chalazal region.

The two layers of the outer integument do not undergo any change. The cells of the inner layer of the pericarp are highly cutinized. In the 5-6 middle layers, the cells are transversely elongated. The cells of the outer layer of the pericarp contain starch grains and large vacuoles. The hypodermal layer develops teeth-like projections and the cells contain tannin.

54. Embryological studies in the Genus *Phaseolus*.

J. VENKATESWARLU and N. V. SUBBA RAO, Waltair.

Embryology of *Phaseolus aconitifolius*, Jacq., *P. trilobus* Ait., and *P. radiatus* Linn. (Chinese variety) have been studied. The floral whorls develop in an acropetal succession. The anther in its structure shows epidermis, 3 wall layers (except in *P. trilobus* where there are only 2 wall layers) and a secretory type of tapetum of parietal origin. Ultimately the outermost of these becomes differentiated as fibrous endothecium. The tapetal cells remain uninucleate throughout. The division of the pollen mother cell is of the simultaneous type. Cytokinesis takes place by furrowing. The pollen grains are 2-celled at the time of shedding and show 3-germ pores in the exine.

The ovules are bitegmic, anacampylotropous and crassinucellate. The archesporium consists of a single hypodermal cell. A parietal cell is cut off. Two or 3-cell thick parietal tissue is formed. Occasionally 2 or 3 megaspore mother cells are formed in the same ovule. The megaspore mother cell undergoes usual meiotic divisions and a linear tetrad of megaspores is formed of which the chalazal one is functional. The embryo sac develops according to Polygonum type. The components of the 8-nucleate embryosac show normal structure. Synergids are hooked. Upper part of the embryosac enlarges very much and destroys the nucellus above it and on its sides.

Fertilisation is porogamous.

Endosperm is of the nuclear type. In the upper part it becomes cellular in advanced stages of development. The endosperm is completely absorbed by the embryo in the mature seed.

Embryo development has been studied in *P. aconitifolius* and *P. trilobus*. It conforms to the Onagrad type and keys out to *Lotus* variation of Johansen.

Seed coat is formed by the outer integument alone in which vascular stands are present.

55. Contribution to the Embryology of *Talinum triangulare* Willd.

J. VENKATESWARLU and S. R. MAZUMDAR, Waltair.

The development of the floral organs takes place in an acropetal succession.

The anther, in its structure, shows epidermis, 3 wall layers and secretory type of anther tapetum of parietal origin. The primary sporogenous cells undergo a few transverse divisions only so much so the spore mother cells are always found arranged in a single row. The tapetal cells are binucleate. The division of the pollen mother cells is simultaneous. Cytokinesis is by furrowing. Both tetrahedral as well as isobilateral tetrads are found. Pollen grains, at the shedding stage are 3-celled. Pollen grains are smooth-walled and multiporate.

The ovule is ana-campylotropous, bitegmic and crassinucellate. The micropyle is formed by the inner integument alone. A characteristic air-cavity is seen at the base of the ovule between the two integuments, as in other Centrospermales.

The primary archesporium is 1-celled. A linear tetrad of megaspores is formed and usually the chalazal megaspore is functional. Occasionally the one above the chalazal enlarges in size and becomes functional. An 8-nucleate embryosac is developed according to the Polygonum type. The synergids are hooked. Antipodals are 3 in number and are arranged in a linear row in the narrow chalazal end. Starch grains are found abundantly in the mature embryosac.

Fertilisation is porogamous. Richly protoplasmic, elongated cells are developed from the placenta, which hang over the micropyles of the ovules and these function as an obturator.

Endosperm is of the nuclear type. It is almost completely consumed in the mature seed.

Embryo development has been studied in detail. It conforms to the Caryophyllad Type and keys out to *Vaccaria* Variation.

The seed is exalbuminous and contains little perisperm. The seed coat is of two layers in the mature seed and both the integuments contribute to its formation.

56. Embryological studies in a few Asclepiadaceae.

H. MAHESWARI DEVI, Waltair.

This paper deals with the life history of *Calotropis gigantea*, megasporogenesis, female gametophyte and fertilisation of *Pergularia* sp. and female gametophyte of *Ceropegia juncea* Rox.

The anther in *Calotropis gigantea* is 2 locular and shows the translator mechanism. The anther structure shows 4 wall layers, secretory type of tapetum and sporogenous tissue under the epidermis. No fibrous endothecium is differentiated. The anther tapetum becomes multiseriate and the cells remain uninucleate throughout. Cytokinesis is by furrowing. The primary sporogenous cells directly become the microspore mother cells. Pollen grains are shed at a 3 celled stage and are loaded with starch grains.

The ovule in all the three plants is tenuinucellate, unitegmic and anatropous. The single hypodermal archesporial cell directly becomes the megaspore mother cell. A linear tetrad is formed. The chalazal megaspore of the tetrad develops further giving rise to the Polygonum type of embryo sac. The mature embryo sac contains abundant starch grains.

Fertilisation is porogamous. Pollen tube is persistent.

Endosperm is of nuclear type.

Embryo development is according to the Solanad type.

(vii) Angiosperms (Anatomy)

57. Studies on the occurrence of Sclerenchyma in the Floral organs of the compositae—I. *Helianthus Annus* L.

N. RAMIAH, Hyderabad-Dn.

Occurrence of sclerenchyma is reported for the first time in floral organs other than the seed coat and fruit wall, like the involucre bracts, paleae and pappus lobes of *Helianthus annus* L. It is considered as extra-fascicular in origin, since vascular bundles in such organs are found to be very much simplified and are devoid of sclerenchyma which is usually present in them in the stem, root etc. Distribution of sclerenchyma in the epidermal and ground tissues of the several organs increases progressively in bracts-paleae-pappus sequence. In the bracts it is present in the form of vertical parallel strands forming a part of the ground

tissue. These strands continue to nearly a centimeter or above from the proximal end. But the outermost bracts are however usually without any such sclerenchyma. In the paleae, the epidermal cells of the distal end show the first symptoms of sclerification in the form of slight axial elongation and thickening of the cell wall. The sclerenchyma strands in the ground tissue are very large in diameter and traverse upto the distal end. In addition many ground cells lying near the sclerenchymatous and vascular strands also undergo considerable thickening and bear simple pits. There are also occasional stray ground cells which are perhaps potentially idioblastic and therefore develop into sclerosed elements and these are haphazard in their distribution. In pappus lobes the entire epidermal and ground cells are transformed into sclerenchyma barring some basal cells in the pappus of the ray florets.

Sclerification of cells belonging to each of the tissue systems is associated with elongation of vertical walls, development of lignified secondary thickening and tapering of the ends. The simple and round to slit-like pits are distributed on such walls which are in contact with some other cells. The external free cell wall as found in the sclerosed epidermal cells of the pappus lobes, are therefore without any pits. From the spindle form the thickening with variable amounts of lignin and the round to slit-like pits, the sclerosed elements are recognised as fibres. Functionally the fibre cells present in the paleae in the form of strands are considered not only to strengthen the tissue in which they are found but also to participate in the water conduction along with the tracheary elements. Moreover the pappus lobes are regarded as modified sepals instead of compound trichomes as previously established by Small.

58. Development of some of the Trichomes in the Compositae. I. Biseriate vesicular glandular hair.

N. RAMIAH, Hyderabad-Dn.

The present contribution is a part of much larger work concerning the distribution and development of some of the trichomes met with in the Compositae which is being carried on by the author. It describes the development of "biseriate vesicular glandular hair" found on the head structures of *Ambrosia psilostachya* DC; this hair form is known to be very wide spread in the family.

A hair initial is conspicuous by its dense cytoplasm, large nucleus, enlarged size and being protruded from the epidermis. To begin with it divides vertically and gives rise to 2-juxtaposed daughter cells. Thus the biseriate organisation characteristic of this hair is decided by the very first wall laid down, as from divisions of these two cells alone that the two rows of cells are developed. Further development of the hair until its completion involves in all, three transverse divisions which occur successively in the above two cells and their products. Thus a fully developed hair consists of sixteen cells arranged in two rows. The two terminal cells are conspicuous by dense cytoplasm, a large nucleus and a conspicuous vacuole. These are the chief secreting elements and are enclosed by a cuticular vesicle in which secretions are accumulated. The rest of the cells possess only a contracted nucleus and scanty protoplasm and probably these do not participate in the glandular function.

In many cases it is found that the last division fails to occur in one or two octants of the basal or the next pair of cells. As a result, hairs bearing a reduced number of cells like 15-13 only, are frequently observed. Hence it is important to note in connection with the development of this hair that reduction through incomplete differentiation is quite frequent.

59. Studies on the occurrence of Sclerenchyma in the Floral Organs of the Composite III. *Vicoa indica* DC.

N. RAMIAH, Hyderabad-Dn.

This is the third Compositae plant belonging to the group Inuleae that has been studied in regard to the distribution of sclerenchyma in the floral parts. Sclerenchyma occurs not only in the bracts and pappus but also in corolla, stamens and style. Sclerosis is accompanied with lignification in all of them except the style.

In bracts the abaxial hypodermal ground tissue upto 4-5 layers is composed of sclerenchyma but the same gradually diminishes towards the apex by a progressive replacement with parenchyma in the mid-rib region. Hence in the upper portion it is limited to the wings only. The scarious margins are not owing to the ground sclerenchyma but are a result of complete lack of the very ground tissue in those parts and also to the presence of thick cuticle externally on the epidermis. The sclerosed elements are fibre like in general but those at the base are short and bizarre as in the paleae and pappus lobes of *Helianthus annuus* L.

The setose pappus parts are composed of all sclerosed cells and are without ground and vascular tissues unlike in *Helianthus annuus* L. Their large number is attributed to either an early ontogenetic or a phylogenetic division of the pappus meristem into many parts which finally failed to differentiate the ground and vascular tissues. Thus the setose pappus of the present plant is regarded by the author to be foliar in origin unlike the trichomatic origin of the same held by Small.

Both the epidermal and ground cell upto 2 mm. in height present at the base of the corolla tube are sclerosed into fibres but they least resemble with typical fibres. They are also characterised by the retention of protoplasm even after thickening of the walls.

In stamens the entire epidermis and probably the ground tissue of the connective, anther lobes and a small portion of the filament just below the anther lobes is totally sclerified. Anther tails which are a characteristic of the present plant as in the whole of its tribe are only extraordinarily elongated basal epidermal cells of the anther lobes and the near by connective region; these cells so elongate owing to sclerosis.

The inner epidermal and some next hypodermal layers of the style wall at the upper regions are sclerosed but do not show lignin in the same.

60. Characteristics of fibre bundles in different species of *Agave*.

A. K. DATTA and B. C. KUNDU, Calcutta.

The fibre obtained from different species of *Agave* differs with regard to quality. The difference in quality of these fibres is due to the variation in structure of fibre strands and the ultimate fibres and their nature of orientation in the leaves.

The present work deals with characteristics of fibre bundles and their number per unit area of the leaves of different species of *Agave*.

Sisal fibres are found in the form of strands or bundles of ultimate fibres running parallel through the length of the leaf. The cross section of the leaf shows that the fibre bundles are scattered in the mesophyll tissue. Most of them are fibrovascular bundles of collateral, bicollateral and semi-concentric types; pure fibre bundles are small, round, very few in number and are situated near the lateral margins of the leaf. Smaller fibre bundles are crescent to kidney shaped over the vascular bundles. The large fibre bundles form two arcs covering the vascular bundle.

Preliminary studies with four different species of *Agave* show that *Agave cantala* has the maximum density of fibre bundles (3.80, 2.65) in an unit area whereas *A. sisalana* (1.50), *A. veracruz* (1.60, 1.50) and *A. wightii* (2.1) have much less number.

Detailed study of the two species, *A. sisalana* and *A. cantala* shows that there is a remarkable difference in the number of fibre bundles amongst them. The statistical analysis of number of fibre bundles from different positions are summed up as below :

		<i>A. sisalana</i>	<i>A. cantala</i>	Critical difference at 1% level
Mean fibre density (centre)	...	1.749	2.000	0.234
" " " (intermediate)	...	1.922	2.347	0.184
" " " (margin)	...	2.402	2.983	0.275
" " " (base-whole)	...	2.024	2.443	0.229

It appears from above that the differences in the average number of fibre bundles at 3 different positions in the basal region are highly significant at 1 per cent level. Considering the basal region as a whole the average number also varies in both the species. It is also evident from the above that the density of fibre bundles at 'centre' is minimum and it gradually increases towards the margin. Thus the average number of fibre bundles per unit area at the basal region of the leaves of *A. cantala* and *A. sisalana* may also be utilised for the identification of these two leaves.

61. The structure of motile pulvini and the difference between autonomic and nastic types.

(MRS.) MRIDULA DATTA, Calcutta.

In contrast to unspecialized leaf bases which resemble the stem axis to a great extent, the structure of motile pulvini show some variations from the usual pattern. The more active the member, the more does it take the cylindrical form. In transverse section, the main pulvinus of *M. pudica* is only slightly grooved while that of the semi-motile *Averrhoa* is more so. The tiny elongated pulvinule of the powerfully active *Desmodium gyrans* is a perfect cylinder. The tissue systems are modified in the following way. The epidermal system as the receptor region is modified in that it forms an air tight skin, devoid of stomata and guard cells. Hairs are specialized and strictly localized with regard to the structure and function of the plant area on which they occur. The vascular system is greatly reduced in bulk and confined to the centre of the organ. It is rendered pliable firstly by a limited lignification of the vessels and secondly by these having only scalariform and reticulate thickening. Pitted vessels are at a minimum. The bulk of the motor organ is composed of a modified cortex. There is no mechanical tissue in the form of sclerenchyma but there is only extensible soft-walled parenchyma. Cells are isodiametric and loosely arranged in aerenchymatous fashion. They are green but devoid of starch, the latter being limited to the endodermal layer. The cortex is so arranged that when one side of the pulvinus contracts, the other expands. During expansion, not only do the individual cells increase in area but the tissue as a whole enlarges in bulk and the intercellular spaces open out. During closure the reverse process takes place. These characters are found to be common to all motile pulvini. As regards the difference between an up and down nastic movement and a gypatory autonomic movement, the following structures are most important as related to their function. Nastic cortices are dorsiventrally differentiated and an upper and lower side can be made out, while the cell

structure in all parts of the autonomic pulvini are uniform. The inner area of nastic pulvini is more aerenchymatous than the outer tissue, while in autonomic pulvini the spongy nature is uniform. The phloem occurs in two strands on the two surfaces of the xylem in nastic pulvini, in which conduction of stimuli is important, whereas in autonomic pulvini where no such conductivity is developed, there is only an external strand of phloem. For nastic material, *Mimosa pudica*, *M. Spegazzinii*, *Biophytum sensitivum* and *Averrhoa carambola* were studied, while for autonomic pulvini *Desmodium gyrans* and *Oxalis repens* were available.

62. "Shoot Apex Organization in Convolvulaceae".

SM. BIDYUT GANGULY, Calcutta.

1. The shoot apex organization of the following plants belonging to the family *Convolvulaceae* has been studied. *Ipomoea pulchella*, *Evolvulus alsinoides*, *Merremia emarginata*, *Cuscuta reflex*, *Porona paniculata*, *Hewittia bicolor* and *Quamoclit pinnata*.

2. The shoot apex in all the cases passes through a distinct plastochron and shows variation in the diameter at different stages. At the late plastochron stage, the measurement of shoot apices in the different genera are: *C. reflexa* 197.57 μ , *H. bicolor* 127.68 μ , *I. pulchella* 123.69 μ , *Q. pinnata* 114.353 μ , *P. paniculata* 107.78 μ , *M. emarginata* 85.85 μ , *E. alsinoides* 52.668 μ .

3. The number of tunica layers is four in the plants studied. But in *C. reflexa* sometimes three layers are found.

4. Variation in the tunica layers has been noted before and after bud initiation. In all the genera, the number of tunica layers after bud initiation is three. But in *C. reflexa* and *E. alsinoides* two layers have also been noted. In one case, in *C. reflexa*, periclinal division in t_1 has been observed.

5. The corpus is distinct in *C. reflexa*, *E. alsinoides* and *I. pulchella*, but not well differentiated in *M. emarginata*, *H. bicolor*, *Q. pinnata* and *P. paniculata*. The corpus consists of thirty-five to fifty cells. Its cells divide in all the planes.

6. The rib meristem cells are highly vacuolated and occur in files. In *C. reflexa*, *P. paniculata* and *I. pulchella*, they are considerably extended on account of the climbing habit of the plants.

7. The marginal meristem is distinct in all the cases.

8. The initiation of the foliar organs take place by periclinal divisions in t_4 , t_3 and t_2 layers of tunica, and results in the formation of 'basementfoliaræ' in all the cases.

9. The prodesmogen strands are acropetal in development.

63. Studies in the Leaf-Form and Venation of Vascular plants—III (Rubiaceae).

(MRS.) PADMINI DEVI KRISHNAN, Annamalainagar.

A study has been made of leaf form and venation in the family Rubiaceae on similar lines as in previous year. (Singh & Padmini Devi: *Proc. Indian Sci. Cong.*, 1953; Padmini Devi: *Proc. Indian Sci. Cong.*, 1955, p. 228). The following 26 species spread over 18 genera were duly investigated:

(1) *Morinda tinctoria* Roxb., (2) *Hamelia patens* Jacq., (3) *Mussaenda frondosa* Linn., (4) *Pentas lanceolata* Forsk., (5) *Stephegyne parvifolia* Korth., (6) *Hamiltonia sauecolens* D. Don., (7) *Mitragyna parvifolia* Korth., (8) *Ixora singaporensis* Hort., (9) *Ixora grandiflora* Schlecht., (10) *Ixora parviflora* Vahl., (11) *Ixora rosea* Sims., (12) *Ixora stricta* Roxb., (13) *Spermacoce hispida* Miq., (14) *Portlandia grandiflora* Linn., (15) *Anthocephalus cadamba* Miq., (16) *Rondeletia speciosa* Lodd., (17) *Gar-*

denia citriodora Hook, (18) *Gardenia gummifera* Linn., (19) *Gardenia florida* Linn., (20) *Webera corymbosa* Willd., (21) *Coffea arabica* Linn., (22) *coffea robusta* L. Linden., (23) *Pavetta indica* Burm., (24) *Catesbaea spinosa* Linn., (25) *Oldenlandia* sps., (26) *Oldenlandia paniculata* Linn.

A tentative classification has been erected on the basis of the foresaid studies, with special reference to venation, size, shape and apex of leaves, and has been briefed as under :

I. Veins distinct.

1. Lateral veins proceeding towards the apex.
2. Lateral veins proceeding towards the margin.
 - (a) Intramarginal venation distinct.
 - (b) Intramarginal venation indistinct.
 - (i) Apex shape.

II. Veins indistinct.

1. Lateral veins faintly distinct.
2. Lateral veins completely indistinct.
 - (a) Apex shape.

A new approach to the classification in Rubiaceae has been made from a study of the angle formed by the secondary veins, in relation to the midrib, in leaves, from base to the apex, of each of the species. The data so collected when graphed, each species exhibit a characteristic curve. After close scrutiny, all the twenty-six species studied have naturally come to be grouped under six families of curves. A correlation appears to have been established, namely that the complexity of curve is directly proportional to high evolutionary tendencies of the species, in the family Rubiaceae.

64. Anatomical and Morphological Changes during Vernalisation in Embryo of Mustard T. 102.

B. SEN and H. C. JOSHI, Almora.

Anatomical and morphological studies of the embryos of differently treated seeds of mustard T. 102 have been undertaken. Seeds from which embryos were isolated were (i) control, (ii) seeds soaked for 24 hours in glass distilled water and dried and (iii) seeds chilled for 1, 2 and 4 weeks.

From 10 μ longitudinal and transverse sections, it was found that the normal mustard embryo consists of an epicotyledonary meristem with 2 embryonic leaves, one bigger than the other, a procambial cylinder around the pith in the upper region and a core below.

The apical meristem consists of a single row of a regularly arranged tunica cells which covers the irregularly arranged corpus cells below. From the procambial strand of the hypocotyl elongated dark staining procambial cells are traceable in the embryonic leaves. No discontinuity of these strands could be observed.

Soaking of seeds in glass distilled water for 24 hours initiates meristematic activity of the cells of tunica and corpus resulting in a differentiation of the apical meristem and the embryonic leaves. Similar differentiation is seen in the apex of the embryo of seeds chilled for 1 week.

With the increased period of chilling the number of tunica and corpus cells increases, along with increased cell differentiation arrangement of the corpus cells changes. They are arranged in regular rows. Up to 4 regular can be seen in the apex of the seeds vernalised for 4 weeks. Periclinal divisions are seen in the sub-surface layer of the apex but further activities of these cells for the formation of the leaf primordia do not seem to take place during vernalisation.

There was a progressive differentiation of embryonic leaves in the embryos of seeds chilled for increased periods.

This study was undertaken in connection with the Indian Council of Agricultural Research scheme of Plant Physiology and Cytology.

65. A note on the variability of the vascular pattern in the hormone-induced adventitious roots of isolated dicot leaves.

S. K. SINHA, Cuttack.

The vascular pattern of the hormone-induced roots was investigated in isolated dicot leaves of three distinct categories of 1. where no adventitious roots develop in the plant under natural conditions, 2. where the adventitious roots in the plant show variation in the stelar structure within narrow limits and 3. where the variation in the vascular pattern of roots is too wide. The species were selected from each category. It was found that in all species induced roots were variable in their stellar structure. In the species where the stellar structure is not much variable in the plant, the hormone-induced roots showed quite complex structure. In the species where variation under natural conditions is too great, the degree of complexity in the leaf roots was less, which is probably due to some factors in the leaf affecting the size of the roots.

66. Morphological Development of Root Nodules on *Crotalaria juncea*.

NIRMAL ARORA, Delhi.

Small protuberances are seen on the tap root with the unfolding of the first leaf. These grow into large, cylindrical tubercles with branched tips, pink in colour. Bacteria invade the roots through the root hairs and induce meristematic activity in the cortex. The spread of rhizobia into the newly formed tissues is by the division of the infected cells. During spindle formation the rhizobia collect at the poles and are evenly divided when the cell plate is laid down. Therefore all the cells of the bacteroid area are infected.

At maturity the bacteroid zone is surrounded by thin-walled parenchyma and the root cortex. However, the two cannot be easily differentiated. Occasionally the cortical cells of the nodule show starch grains in them.

Two to five vascular strands connect the nodule to the parent root stele. The strands arise at different levels from different protoxylem arcs and their branches ultimately encircle the bacteroid area. The vascular bundles are bicollateral at the base and collateral or inversely collateral higher up. Each has an individual endodermis.

The invaded cells retain their isodiametrical shape even after enlargement. They have a large vacuole in the centre and a small nucleus on the side. Degeneration as evidenced by mottling of the cell contents begins at the base of the nodule and proceeds upwards, finally resulting in a hollow cavity.

Tetraploid cells were frequent in the meristematic region at the apex while the diploid number occurs in the uninfected cells of the cortex.

Ineffective nodules show poor infection, and early disintegration.

67. Morphological Study of the Root Nodules on *Cajanus indicus*.

NIRMAL ARORA, Delhi.

Large, more or less elongated nodules are sparsely distributed on the root system of *Cajanus indicus*. Infection of the roots occurs through root hairs, where

the rhizobia are aligned into a thread-like structure. The epidermal cell forming the hair swells and its walls thicken considerably.

The rhizobia stimulate the cortical cells to divide and the nodule is exogenous in origin. The spread of the invading agent in the newly formed cells is through infection threads. The differentiation of tissues is, however, delayed and sclereids are noticed in the cortex soon after the appearance of a few cells full of bacteria.

A mature nodule shows a well marked bacteroid area, apical meristem and vascular zone. At the outer boundary of the nodule corex a layer of thick-walled, pitted sclereids is conspicuous.

The bacteroid area is composed of two types of cells. In a large nodule 80 per cent of these are uninfected. They remain small in size and have scanty cytoplasm. On the other hand the infected cells are radially elongated. A hypertrophied nucleus is situated in the centre and there are no vacuoles. However, the uninfected cells are packed with large starch grains.

Two vascular strands arising near the root protoxylem supply the nodule. The vascular bundles may be collateral, inversely collateral or bicollateral. In later stages they show the development of secondary elements.

With the onset of degeneration, small vacuoles arise in the largest bacteroid cells, their contents appear mottled and are soon absorbed. Thus large empty cells are found in the infected zone.

The root nodules of *Cajanus indicus* differ from the earlier described herbaceous nodules (Allen & Allen, 1954) in having a sclereid layer in its cortex, in a diffuse method of tissue disintegration and in the fact that the orientation of xylem and phloem is not constant.

68. Contribution to Our Knowledge of the Physiological Anatomy of Some Indian Hydrophytes. III. The Stem of *Cleome chelidonii* Linn.

M. V. MIRASHI, Nagpur.

Cleome chelidonii Linn., a member of the family Capparidaceae, is an amphibious species growing usually on the margins of ponds and lakes. The author first describes an ecologically different form of this species. This form has been reported so far from only one locality in Nagpur. It grows in the months of May and June and disappears by July when it is rapidly superseded by the usual amphibious form. The dry land form differs from the usual one in its dwarfness, more profusely branched habit, the general roughness and hairiness of its vegetative parts, the number and form of the leaflets of its compound leaf, and the colour, and size of the petals and stamens. An intermediate form that possesses the vegetative habit of the dry land form and the floral characters of the amphibious one is also described.

Anatomical investigation of the three forms shows characteristic differences in the pith region. The pith of the dry land form is a compact thinwalled parenchymatous tissue. On the other hand the amphibious form shows an extensive development of a lacunar pith which is traversed by a large number of schizogenous air-spaces that give the pith a net-like appearance. The intermediate form has small intercellular spaces in the region of the pith. The morphological differences noted above in the different ecological forms of the species are thus supplemented by differences in their anatomy also.

Attention has also been drawn to other anatomical characters of physiological importance like the thickwalled epidermis, the compact photosynthetic cortex and the well-developed mechanical and conducting systems. The plasticity of structure and form exhibited by this marsh species and the physiological advantage of the development of a lacunar pith are also discussed. The phylogentic significance of the potentialities for adaptation to a watery habitat as revealed in the morphology

and anatomy of *Cleome chelidonii* Linn., which belongs to a family that is comparatively primitive and shows distribution in the drier areas, is stressed.

69. On the Structure and Development of Velamen in the Roots of some Terrestrial Orchids.

B. N. MULAY and M. K. PRASAD, Pilani (Rajasthan).

1. Velamen is observed in the terrestrial roots of four Orchids, viz., *Liparis atropurpurea*, *Phajus albus*, *Microstylis wallichii*, and *Habenaria cephalotes*.

2. In *Liparis atropurpurea* and *Habenaria cephalotes* velamen is usually one layered. In *Phajus albus* it is two layered and in *Microstylis wallichii* four to six layered.

3. Velamen is probably developed from protoderm in all plants excepting *Microstylis wallichii* in which it has independent origin.

4. A well developed exodermis is found in all the plants.

5. In all the plants exodermis can be made out at the apex at the same level where the protoderm is distinguished.

6. In *Phajus albus* and *Habenaria cephalotes* tracheid like cells are found in the cortex.

7. In *Liparis atropurpurea* and *Habenaria cephalotes* collateral vascular bundles are observed in the roots.

8. Velamen found in these plants is compared with velamen of other plants.

9. Known functions of velamen are discussed and new functions suggested.

70. On the Histological Structure of *Satyrium Nepalense* and other Terrestrial Orchids.

B. N. MULAY and Y. K. SARIN, Pilani (Rajasthan).

1. Historical concepts of velamen are reviewed.

2. The present investigation deals with the origin and structure of velamen in the terrestrial, orchid roots of *Phajus wallichii*, *Habenaria crinifera* and *Satyrium nepalense*.

3. Velamen is present in all the investigated roots and it ranges from one to five layers of cells in depth.

4. Ontogeny of velamen and its structure has been studied.

5. Origin of exodermis and its morphology has been studied.

6. Tracheid like cells have been observed in the cortex of the roots of *Satyrium nepalense*.

7. Both ectotrophic and endotrophic mycorrhiza is observed in these roots.

71. Studies in the anatomy and physical properties of Jack-wood (*Artocarpus integrifolia* Linn.) in relation to the manufacture of South Indian Stringed instruments.

(Miss) STELLA PONNIAH, Annamalainagar.

South Indian stringed instruments like *Veena* and *Tambura* are manufactured out of jack-wood. This is being done empirically by hereditary crafts-men. There is hardly any scientific background or correlation in relation to this empirical knowledge. Therefore, in this communication attempt has been made to tackle this problem from botanical and physical standpoints. As compared to the inferior jack-wood, the superior jack-wood has the following characteristics :

The wood is compact, heavy and in general the diameter of the lumina of wood-vessels is much smaller. The vessels are better lignified and their respective walls are much thicker. Percentage of moisture is less than 10% and the transmission values of various wave-lengths of light through aqueous wood-extract are poorer.

An ecological survey of the plantations of jack-wood was made, and it was found that those growing in the red lateritic arid soils of Pattukottai (Tanjore district) yielded wood which conformed to the criteria given above; and thus they have been found best for the manufacture of *Veena* and *Tambura*.

A plea has been made to recommend to the Government of India, the cultivation of jack-wood on commercial scale in the Pattukottai area as a long range policy for the supply of suitable first class wood for the manufacture of stringed instruments.

(viii) Angiosperms (Palynology)

72. Studies on the Pollen of Crop Plants—Mustard (*Brassica campestris* var Yellow Sarson Prain) and Garden Pea (*Pisum sativum*)—II.

B. SEN and GYANENDRA VERMA, Almora, U.P.

Garden Pea : Studies with six varieties of Garden Pea, viz., Miller, Schilling, First-to-Report, Early Badger, Delwiche Commando and Borrville showed that as compared to room temperature (10-12°C.) increased germination and elongation of pollen tubes was obtained at 15°C. to 21°C. At temperatures below 12°C. the germination was comparatively poor, while at 24°C. the pollen tubes burst profusely.

Effects of incorporating micro-doses of Vitamins B₁, B₂, B₃ and B₆ in the germinating medium on the pollen tube were studied. The optimum concentrations of vitamins, and the length of pollen tubes of Garden Pea Miller after 24 hours were : Vit. B₃, 0.05 ppm.—1588 microns; Vit. B₆, 1.5 ppm.—1390 microns; Vit. B₂, 2 ppm.—1295 microns; Vit. B₁ 0.5 ppm.—1004 microns; control 10% sucrose and 1% agar—888 microns.

Mustard : Effect of high temperature 20°-25°C. was found to be well marked both on the germination and pollen tube growth. Pollen elongation at 20°-25°C. was 250 microns as compared to 160 microns at 10°-12°C.

Optimum concentrations of Vitamins B₁, B₂, B₃ and B₆ when incorporated in the germinating medium (20% sucrose and 1% Agar) stimulated the growth of pollen tubes in the following order; Vit. B₃, 0.5 ppm.—392 microns; Vit. B₆, 1.0 ppm.—354 microns; Vit. B₂, 0.5 ppm.—302 microns=Vit. B₁, 0.1 ppm.—298 microns; Control 240 microns.

These investigations were carried out in connection with the scheme of Plant Physiology and Cytology financed by the Indian Council of Agricultural Research, New Delhi.

73. Studies in Pollen Germination in some Cucurbitaceae.

I. K. VASIL, Delhi.

Using the hanging drop technique, pollen of *Cucumis melo* L., *C. melo* var. *momordica* Roxb., *C. melo* var. *utilissimus* Roxb., *Citrullus vulgaris* Schrad., *Benincasa hispida* Cogn., *Momordica charantia* L., *Luffa acutangula* Roxb., and *L. cylindrica* Roem. (syn. *L. aegyptiaca* Mill.) was germinated in artificial nutrient media. In all these species the pollen is triangular or spherical with 3 germ pores and is shed at the 2-celled stage. The exine is thick and shows characteristic sculpturing.

In 1.25-40% sucrose, the pollen grains germinate satisfactorily but the tubes grow slowly and usually attain a length of about 1,000 microns, after which they burst. However, with the addition of 0.01% boric acid, percentage of germination, rate of elongation and length of the pollen tubes increases. They reach 2000-4000 microns in 2-4 hours after sowing. The nutrient media, percentages of germination, and the tube length obtained in different cases are as follows :

Name of plant	Nutrient medium		Maximum germination %	Max. tube length in microns
	Sucrose %	+ Boric acid %		
<i>Cucumis melo</i> ...	20	0.01	90	3960
<i>C. melo</i> var. <i>momordica</i> ...	10	do	92.06	2520
<i>C. melo</i> var. <i>utilissimus</i> ...	12.5	do	80	2970
<i>Citrullus vulgaris</i> ...	7.5	do	70	2232
<i>Benincasa hispida</i> ...	10	do	60	3960
<i>Momordica charantia</i> ...	10	do	64.38	2988
<i>Luffa cylindrica</i> ...	20	do	90.6	3312
<i>L. acutangula</i> ...	10	do	70.34	2779.2

The effect of dextrose and fructose on the pollen tube growth of *Momordica charantia* and *Cucumis melo* var. *utilissimus* has also been observed. In simple dextrose and fructose solutions most of the grains burst and only a negligible percentage produces short tubes. Addition of 0.01% boric acid raises the percentage of germination and tube length. Fructose does not seem to be favourable for pollen tube growth while dextrose serves as well, or perhaps better, than sucrose.

The various phases of division of the generative cell in the pollen tube have been followed. Acetocarmine, propionocarmine, and Haidenhein's haematoxylin with fast green as counter stain, were used for staining. Callose plugs are commonly formed in the tubes and after they have attained the maximum length, their walls get thickened to such an extent that in some cases only a narrow lumen is left and the tube appears like a fibre.

(ix) Angiosperms (Cytology and Genetics)

74. Primary effect of X-rays on the differentiated meiotic chromosomes.

S. S. BHATTACHARJYA, Calcutta.

Impatiens plants of different species were subjected to X-radiation with varying dosages of 100r, 200r, 300r, 500r and 800r. Flower buds with praemeiotic resting stages of nuclei in their pollen mother cells were X-rayed and the effects of irradiation were determined afterwards in the Metaphase I onwards of the cells. It was found that the less the time lag between irradiation and analysis the more was the prevalence of the physiological effect of irradiation. The physiological effects were of the nature of inhibition of nuclear division, reversion of the dividing nucleus to the previous phase of division, agglutination and 'stickiness' of the chromosomes, clumping, disturbances of the spindle mechanism etc. It was noted that with an increase of the dosages the frequency of the primary effects increased correspondingly. The subsequent appearance of the secondary effects were similarly dependant on dosage. The extent of the physiological disturbances of the irradiated nuclei was governed largely by the constitution of the chromosomes. It was thus found that nuclei with rich heterochromatic contents were more affected. Moreover the intercalated heterochromatin type of a chromosome, i.e. a chromosome where blocks of heterochromatin are sandwiched between blocks of euchromatin—showed heavy clumping and late recovery. One of the causes for such

physiological effects may be attributed to the depolymerisation of the nucleic acid of the chromosomes after X-radiation. In our experiments we found also that the heterochromatin was more affected since it was fully charged with nucleic acid in the praemeiotic resting stage of the nuclei. It could be also confirmed that the deposition of the matrix substance in the meiotic chromosomes increased from Prophase to Metaphase I. These factors together with the less time-interval between irradiation at resting stage and analysis at Metaphase I of the nuclei, may account for heavy clumping and agglutination and other physiological effects in the differentiated chromosomes of *Impatiens* after irradiation.

75. Studies on the structure and behaviour of chromosomes of a few species of the family *Amaranthaceae*.

SUBIR SEN, Calcutta.

The cytology of five genera and seven species belonging to *Amaranthaceae* has been studied. The meiotic process appears to be normal with slight deviations. The chromosome number is as follows:—*Achyranthes aspera*, $n=21$; *Amaranthus viridis*, $n=17$, $2n=34$; *A. spinosus*, $n=17$, $2n=34$; *A. gangeticus*, $2n=34$; *Digera arvensis*, $n=9$, $2n=18$; *Celosia cristata*, $n=18$, $2n=36$; *Gomphrena globbosa*, $2n=40$. The morphology of the somatic chromosomes of most of the plants have been studied. The presence of Sat-chromosomes have been described. Types of chromosome distribution in the different genera of the family with special reference to the tribe *Amarantheae* of Engler have been discussed.

76. Cytological Investigations in some genera of the grasses.

R. P. ROY and D. N. SINGH, Patna.

The classification of the Gramineae in general and that of certain groups in this family in particular is far from satisfactory. The same forms have been placed under different genera or species by different authors. Cytological investigations of such forms are, therefore, very desirable and even imperative to put the classification on a sound basis. It is hoped that such investigation may throw considerable light on the inter-relationship and origin of many species.

With this aim in view cytological investigations are being carried on in the group Rottboellastrae. Chromosome numbers of *Mnesithea perforata* ($2x=18$), *Rottboellia exaltata* ($2x=36$) and *Hemarthria compressa* ($2x=36$) have been determined and their idiograms have also been prepared. Meiotic studies of these species have also been done which show normal bivalent formation except that in some cells there are some lagging bivalents and inversion bridges indicating heterozygosity presumably due to out-crossing. From a comparison of the idiograms it appears that a set of 18 chromosomes in *Rottboellia exaltata* and *Hemarthria compressa* are very like those of the 18 chromosomes of *Mnesithea perforata*. This indicates that the 36 chromosomes species in this group have possibly been derived from two 18-chromosomes species by the process of amphidiploidy. Further investigations are continuing in raising the hybrids between 18-chromosomes species and also producing the autotetraploids of the diploid species which alone are expected to throw light on the origin of thirty six chromosomes-forms.

77. Genome Analysis of *Aegilops sharonensis*.

R. P. ROY, Patna.

The genome analysis of most of the species of *Triticum* and *Aegilops* have been very successfully carried out by Kihara and Lilienfeld and these workers have now

concluded their programme of research on this aspect (Tilienfeld, 1951). One species *Aegilops sharonensis* has however, not received full consideration. The genome of this species has been reported to be like that of another related species *A. longissima*. But no data have so far been presented to support this conclusion.

The interspecific hybrids of two diploid species ($2n$ 14 chromosomes) *A. longissima* and *A. sharonensis* and reciprocal were raised and chromosome pairing and chiasma frequency were studied. The hybrids showed a range of 6-7 bivalents per cell. Sometimes 0-2 univalents per cell were also observed. The chiasma frequency per cell in the hybrids was lower than that in the parents. The reduction in the chiasma frequency was statistically significant. Male and female fertility in the hybrids was only upto 50% indicating that all the gametes formed do not appear to be viable. This may presumably be due to genic differentiation in the genomes of the two species giving rise to inviable gene combinations as a result of crossing over in F_1 hybrids.

Some amphidiploid hybrids were also made in which the genomes of *A. longissima* and *A. sharonensis* were combined in presence of the AB genomes of the tetraploid wheats. Chromosome pairing in the hybrids showed a range of 18-21 bivalents per cell and the univalent frequency was quite low in the direct and reciprocal crosses. The chiasma frequency in the hybrids was lower than in the parent amphidiploids and this difference in the frequency was statistically significant. However, unlike the partially fertile F_1 hybrid between *A. longissima* and *A. sharonensis*, the amphidiploid hybrids were quite fertile. The difference in the percentage fertility was presumably due to either (i) formation of only balanced gametes due to regular segregation of univalents and occasional multivalents, or (ii) normal functioning of deficient gametes, or (iii) due to some compensation mechanism between the chromosomes of *Triticum* and *Aegilops*, as there were indications from F_1 pairing of intergeneric hybrids that they have some similar blocks of genes.

Several other amphidiploid hybrids involving the tetraploid wheats and other diploid species of *Aegilops* were raised and cytologically investigated. All of them showed high univalent frequency indicating non-homology of the genomes combined.

However, on the basis of chromosome pairing and fertility of the F_1 hybrid of *A. longissima* and *A. sharonensis* and also on the basis of pairing and fertility of amphidiploid hybrids, in which the genome of the two species of *Aegilops* mentioned above, were combined in presence of AB genomes of the tetraploid wheat, both species of *Aegilops* have been assigned the same genomic formula S^1 . But the lowering of chiasma frequency in the F_1 hybrids and amphidiploid hybrids in comparison to parents, and also only partial fertility of F_1 hybrid, are indications of some genic differentiation between the S^1 genomes of *A. longissima* and *A. sharonensis*. They are therefore considered homologous to the same extent as the homologous genomes in diploid, tetraploid and hexaploid species of *Triticum*.

78. An improved method of preparing permanent root-tip squashes with aceto-carmin for counting the chromosomes and studying mitosis.

K. RANGASWAMI, Annamalainagar.

As many of the previous methods for making permanent root-tip squashes with aceto-carmin have not given complete satisfaction as regards clarity of outline and definition of chromosomes, a new method has been developed in this laboratory in regard to the root-tips of *Urginea indica* Kunth. The schedule is as follows:—

1. Immerse the bulbs of *Urginea* with the emerged root-tips in warm water at a temperature between 45°C and 50°C. (5 minutes).

2. Cut up the root-tips by means of a sharp razor blade into very thin slices (0.5 m.m. thick) in tap water.

3. Immediately transfer the material to acetic-alcohol (1 : 3) and fix (10 minutes).
4. Dip the root slices in Conc. H.Cl (1 minute).
5. Transfer the slices into a mixture of equal quantities of Conc. H.Cl and 95% alcohol (2 to 5 minutes).
6. Place the slices in Carnoy's fluid (Acetic acid 1 : Chloroform 3 : Absolute Alcohol 6) (5 minutes).
7. Soak the slices in the aceto-carmin (30 minutes).
8. Squash the slices with albumin-smeared cover glasses on clean slides and warm (5 minutes).
9. Separate the slide and cover glass in 30% acetic acid (5 minutes).
10. Change through grades of acetic-alcohol, 1 : 2 and 1 : 3 (2 minutes each).
11. Absolute alcohol (2 minutes).
12. Mount in Euparal (2 minutes).

The whole process does not take more than an hour and a half and it shows the chromosomes in a very well-defined manner in all the phases of mitosis.

79. Effects of X-rays on the sterility of Pollen grain in *Sesamum orientale* Linn.

K. L. CHAUDHURI and A. DAS, Calcutta.

Study of pollens from the points of view of its sterility and fertility is important in determining the genetical balance of a particular type. In course of an investigation on the effect of X-rays on the genetical behaviour of a few strains of *Sesamum orientale* special attention was given on the point of pollen sterility in the treated populations. For preliminary observations three cultivated types of sesamum were selected viz. Type 10 and 12 (W. Bengal) and T.M.V. 2 (Madras). Dosages applied were 36 m.a.H.=14,400 r units, 140 m.a.H.=56,000 r. units and 200 m.a.H.=80,000 r. units. All the seeds were exposed in the dry state. Pollens were collected from 10 plants selected at random from the populations and mounted in iodine solution and Methyl-glycerine jelly and examined under the microscope. A large number of readings were taken each year. The following table gives the percentage of sterility and their standard errors in different control and treatment.

Table I. Showing the mean percentages of sterility and their standard errors in different controls and treatments.

Variety	X-ray dosage	1951	1952	1953
Type No. 70 ...	Control	3.9 ± 0.39	3.2 ± 0.44	3.6 ± 0.14
	36 m.a.H.	8.7 ± 0.77	—	6.8 ± 0.87
	50 "	8.7 ± 0.70	—	7.5 ± 0.80
	100 "	12.0 ± 0.50	14.8 ± 2.91	—
	140 "	—	11.8 ± 1.24	10.2 ± 0.86
	200 "	—	—	6.7 ± 0.66
Type No. 12 ...	Control	4.1 ± 0.41	4.0 ± 0.71	5.4 ± 0.40
	36 m.a.H.	6.3 ± 0.53	—	4.9 ± 0.58
	50 "	9.2 ± 0.40	—	5.3 ± 0.83
	100 "	12.7 ± 0.92	16.6 ± 1.37	—
	140 "	—	13.3 ± 1.39	14.7 ± 0.92
	200 "	—	—	15.3 ± 1.60
T. M. V. 2 ...	Control	4.5 ± 0.46	3.9 ± 0.68	3.6 ± 0.31
	36 m.a.H.	8.6 ± 0.52	—	—
	50 "	8.4 ± 0.58	—	—
	100 "	10.3 ± 0.98	9.4 ± 1.37	—
	140 "	—	12.9 ± 1.51	11.7 ± 0.79
	200 "	—	—	13.2 ± 1.08

In all the controls the percentage of sterility is very low. Upto 100 m.a.H. treatment the sterility increases with increase in dosage. But the sterility percentage becomes less with higher dosages viz. 140 m.a.H. and 20 m.a.H. in type 10 (1952) and 140 m.a.H. in type no. 12 (1952). In T. M. V. 2, however, there is gradual increase of sterility with higher dosage.

The variances were tested statistically and the 't' values between the controls and treatments and between different treatments have been found to be significant in most of the cases.

The results of the preliminary observations suggest that due to some physico-chemical changes within the embryo as a result of X-ray treatment the severity of high dosages is somewhat neutralised so that the breakage of chromosomes or other factors to which the sterility of pollens is due, are minimized to a considerable extent.

80. Organogenesis in *Polymnia uvedalia* Linn.

S. C. DATTA, Calcutta

The plant *Polymnia uvedalia* L. (Compositae), which has recently gained prominence in U.S.A. as a possible source of an anti-arthritis drug, grows in the Central States of U.S.A. in woodlands and meadows as a large perennial and produces flowers during the months of July to September.

Studies on organogenesis revealed that the lateral roots arise endogenously and the apex is differentiated into the calyptragen layer which is formed early in the ontogeny of the root. The development of other tissues of root follow the same pattern as found in other dicotyledonous roots. The stem apex is characterized by two layers of corpus and three layers of tunica and the vacuolation is found to commence in the fifth or sixth cell layer in the central group of cells derived from the corpus. The development of the leaf agrees substantially with the pattern of development found in other dicotyledons. The axillary buds are initiated by a combination of anticlinal divisions in one or more of the superficial layers of the young axis and of various divisions in the deeper layers. The change from vegetative to flowering apex is noticeable as the floral apex becomes flatter and wider and the characteristic activity of the corpus is discontinued and the elongation comes to a stop. The individual flowers are found to arise acropetally on the flattened receptacle and they follow the common pattern of development found in other Compositae. Microsporogenesis takes place in normal way in the disc florets where the ovaries remain in a rudimentary stage throughout their life. The ray florets show the phenomenon of apomixis and no germination of the apomictically developed fruits were observed. Under natural conditions the plants were found to propagate vegetatively.

81. On the Vernalization of bulbs of *Eucomis*.

S. PANNIRSELVAM, Annamalainagar

Bulbs of *Eucomis punctata* L'Her. were vernalized in kelvinator for a continuous period of 25 days at a uniform temperature of 7°C. in darkness. After the expiry of this scheduled period they were sown in pots with proper controls. It was observed that the vernalized plants matured earlier (i.e. 27 to 36 days) and their vegetative performance was much better than the control plants.

82. Effect of Removing the Cotyledons at 10 Days' Intervals on the Vegetative Phase of Control and Vernalised Plants of Mustard T 102.

B. SEN and GYANENDRA VERMA, Almora, U.P.

Embryos isolated from control and vernalised seeds of Mustard T 102 were grown in glass distilled water along with whole C- and V-seeds for 10 days in dishes kept at room temperature in normal day-light and total darkness. Both embryos and seedlings were sown in pots and cotyledons from a given number of pots were removed at sowing time and at 10 days' intervals thereafter. Thus there were 20 treatments, five each of C- and V-plants kept in normal day light and in darkness, viz., (i) cotyledons intact, (ii) cotyledons removed 10 days before transplanting-embryos, (iii) cotyledons removed at sowing, (iv) cotyledons removed 10 days after sowing, and (v) cotyledons removed 20 days after sowing.

Subjecting the seedlings to darkness in the first 10 days of their life cycle significantly reduced the surface area of cotyledons as measured 20 days after transplanting : (a) C. 10 days light—363.2 sq. mm.; (b) C, 10 days dark—312.3 sq. mm.; (c) V, 10 days light—306.8 sq. mm.; (d) V, 10 days dark—260.9 sq. mm. Also the size of cotyledons from V seedlings was smaller than that from the controls.

Removal of cotyledons prolonged the vegetative phase of plants and shortened the leaf number at which flowers appear. Thus the embryos gave rise to plants with longest life cycle and shortest leaf numbers, followed by treatment (iii) and treatment (iv). Plants of treatment (v) were similar in their vegetative cycle and leaf stage to plants with cotyledons intact. Subjecting seedlings to darkness in early stages of their life cycle also prolonged the vegetative phase.

These studies were carried out in connection with the scheme of Plant Physiology and Cytology financed by the Indian Council of Agricultural Research, New Delhi.

83. Effect of Presoaking and Prechilling of Seeds of Mustard T. 102.

B. SEN and H. C. JOSHI, Almora, U.P.

Study was undertaken to see the effect of (i) presoaking seeds of Mustard T 102 in glass distilled water for 24 hours (ii) pre-chilling seeds for different periods on the growth elongation of the internodes, leaf stage at which the flowers emerge and days required from sowing to the opening of the first flower.

It is found that (i) the length of the internode and their rate of growth elongation is more in plants grown from seeds soaked in glass distilled water than those from control seeds; (ii) with the increased period of chilling the length of the internodes and their rate of growth elongation progressively increases; (iii) compared to plants from untreated seeds, plants from seeds soaked in water for 24-hours flower earlier; (iv) the earliness observed is similar to that induced by chilling seeds for one week and also the leaf number at which the flower buds emerge is significantly less; (v) with the increased period of chilling the vegetative period and the leaf stage at which the flowers emerge, progressively decreases.

The length of the internodes, vegetative period and the leaf stage at which the flowers emerge seem to be dominated by the apical meristem, and all the histological characteristics of the growing apex are reflected in the subsequent growth characters and period of inflorescence of the plants.

This investigation was undertaken in connection with the Scheme of Plant Physiology and Cytology, financed by the Indian Council of Agricultural Research, New Delhi.

84. Vernalisation of Colonial Barley.

B. SEN and S. N. SRIVASTAVA, Almora

Earlier work with vernalisation has shown that the different strains of a crop do not respond to vernalisation. The yield of grain from vernalised plots has generally been found to be lower than that from control plots because the number of tillers, the factor positively correlated with the yield decreases by vernalisation. However, shortening of vegetative phase from the use of vernalised seeds can be effectively utilised in increasing yield if earliness in flowering would make the crop overcome the period of drought or attack of pests and diseases.

Colonial barley demonstrates the possibilities of obtaining increased yield from vernalised seeds. Experiments were conducted for the past 3 years with three varieties of barley—C. 293, T. 5 and Colonial. The seeds were chilled at 2° C. to 5° C. for six weeks.

All the varieties gave good response to vernalisation and the earliness produced was significant at 1% level. The earliness was of the following order : Colonial, 16.9 ± 0.29 days, T. 5, 11.2 ± 1.62 days, C. 293, 9.7 ± 1.47 days.

Colonial barley has a long life cycle and is susceptible to yellow rust (*Puccinia glumarum*). By shortening the vegetative phase this variety can escape the severe damage due to rust infection and this could be done by the use of vernalised seeds.

Results of the past three years show that the yield obtained from vernalised plots of Colonial barley was more than that from control plots, the difference being significant at 5% level. The increase in yield observed was 92%.

Expenses of these investigations were met by the Uttar Pradesh Government in connection with the scheme of Development of Food and Fodder Crops at Vivekananda Laboratory, Almora.

85. Studies on the mutation of *Aspergillus niger* van Tiegham induced by irradiation with ultraviolet rays.

A. K. MISHRA and P. NANDI, Calcutta

Conidia of *Aspergillus niger* were irradiated with ultraviolet rays of 2537 Å, plated out in Czapek Dox agar medium, and colonies arising from irradiated spores picked up at random, and transferred to Czapek Dox agar slants. Observations were made for their changed morphological and cultural characteristics. About 107 mutants were isolated which had either changed morphologically or in the production of citric acid or both. In morphology, mutants were found to have changed in the form and texture of the colony, from normal to fluffy to close textured leathery colonies, in the conidial colour from black to brown, cinnamon, greenish yellow and white, in the formation of sclerotia and in the production of brown to deep orange pigments.

As regards citric acid production 4.6% produced more citric acid, 2.8% produced the same amount as parent, 89.7% produced less and 2.8% failed to have a satisfactory growth on the test medium. The induction of mutation by ultraviolet appears to offer somewhat limited, if not definite, possibilities of increasing the yield of citric acid from *A. niger*, as well as for other micro-organisms, the metabolic products of which are of industrial importance, leading to an increase in their power of fermentation.

86. Cytology of the $2n \times 4n$ population of jute (*Corchorus olitorius* Linn. var C. G.)

G. I. PATEL, Barrackpore and R. M. DATTA, Calcutta

Seven plants of the $2n \times 4n$ population were cytologically analyzed. The meiotic pairing varied greatly. The mean numbers of various associations of chromo-

somes per p.m.c. are 0.12 hexavalents, 1.9 quadrivalents, 0.35 trivalents, 5.0 bivalents, 2.0 univalents and 0.12 fragments. The quadrivalents were commonly noticed in the form of rings and chains. The less frequent occurrence of trivalents than bivalents and univalents suggests that the x-frequency is much less. The Y-shaped configuration of trivalents was common.

Varying number of univalents (1 to 6), laggards, chromosomal bodies lying in cytoplasm and bridges were observed in both the meiotic divisions. Out of 103 p.m.c's analyzed in the first division, 46.4% of them showed these irregularities. Number of p.m.c's noticed with chromosomal bodies eliminated in cytoplasm were much more (34.4%) in the second division of meiosis than the first one (20.3%).

The chromosome number of the plants studied varied from 20 to 35. The female parent used in the cross showed normal meiosis—711, and therefore the production of these aneuploid, euploid and pentaploid plants in addition to the expected triploids ($3n=21$) is obviously due to the functioning of the numerically unbalanced gametes from the pollen parent—auto-tetraploid.

About 80% of the tetrads in the plants studied had normal number of microspores; however, their size was seen to vary. Rest of the tetrads were with 1 or more micronuclei in them besides 4 microspores and with monads till octads with or without micronuclei. The potentially viable pollen grains varied from 46 to 81% in different plants; their size also varied much.

The abnormal meiotic pairing and the subsequent irregular behaviour of chromosomes resulted in the production of unbalanced gametes adversely affecting the fertility of the $2n \times 4n$ population. Most of the seeds produced were shrivelled. Few plums seeds of somewhat varying size were obtained.

87. Interspecific hybridization in *Hibiscus* and the meiotic behaviour in F_1 hybrids.

P. SANYAL, and G. I. PATEL, Barrackpore

Five species of *Hibiscus* *cannabinus*, *sabdariffa*, *radiatus*, *panduraciformis* and *lunarifolius* were hybridized. Hybrids were obtained only between *cannabinus* ($2n=36$) and *radiatus* ($2n=36$); both these species were successfully crossed in either directions, but more easily when *radiatus* is used as the O parent.

Eighteen bivalents were observed in *cannabinus* and *radiatus* at metaphase I. The meiotic pairing of their F_1 hybrids is essentially alike. The maximum number of univalents observed is 18; their mean number is about 15, while the range is rather wide (10-18). The average number of bivalents, trivalents, and quadrivalents observed in these hybrids varied from 9.3 to 10.1 (range 6 to 13); 0.4 to 0.6 (0 to 2); and 0 to 0.2 (0 to 1) respectively. The maximum occurrence of 18 univalents of varying size and 13 bivalents suggests that at least two different genomes—one being common—are involved in the constitution of each of these species.

Eighteen per cent of the sporads were found to be other than the normal tetrads and majority of these had 1 to 5 micronuclei. More than 95 % of the pollen in *cannabinus* and *radiatus* were found to be stained with acetocarmine while in the hybrids 85% of them were non-stained inspite of majority of them being of normal size.

Hybrids produced only a few good seeds on backcrossing with the parental species. They are highly sterile.

Majority of the characters in F_1 hybrids are incompletely dominant, few—bracteoles and shape of the seed—are like *radiatus* and bristleness of the capsule as *cannabinus*.

88. Interspecific hybridization in the genus *Corchorus*.

R. M. DATTA, Calcutta and G. I. PATEL, Barrackpore

Several crosses were made involving (a) different varieties of the two cultivated species at diploid level (b) different wild types of *C. olitorius* and *capsularis* at diploid level (c) wild types of *C. olitorius* and *capsularis* with their cultivated ones at diploid level (d) autotetraploids of wild types and cultivated ones of *C. olitorius* and *capsularis* and their combinations with the diploids (e) pollination of *C. olitorius* by *capsularis* and *vice versa* after reducing the length of their styles to varying degrees and (f) six species—*olitorius*, *capsularis*, *tridens*, *trilocularis*, *acutangulus*, and *siliquosus*—of *Corchorus*.

In case of a, b and c the setting of pods was observed in practically all the crosses but it varied much not only in different crosses but also in reciprocal ones. A large number of the set pods fell down during their growth. The pods that were ultimately harvested were of varying development—from fully developed normal matured pods to slightly developed ones. The quantity and quality (empty, partially full and full) of seeds produced varied greatly in various crosses including their reciprocal ones.

The production of partially full and full seeds indicate that fertilisation occurs; the weight of the full seeds is however less than that of the same number randomly taken from their respective female parents suggesting the under-development of either the endosperm or/and the embryo. The examination of longitudinal sections of the pistils that were collected at 2 days and onwards after cross pollination is hoped to give further clear picture in this direction.

In case of 'd', no pod set was observed when the autotetraploids of both the cultivated species were crossed in either directions. On the other hand, pod setting was quite good—20 to 60%—when the autotetraploids of their wild types were crossed; the seeds obtained from them were however all empty.

No pod set was noticed in case of 'e'. In 'f' the seeds wherever obtained were empty except in case where *trilocularis* was pollinated with Kulkarni Gr. 5 (wild type of *C. capsularis*).

Some plants were obtained in few crosses in case of 'a' but they were found to be due to accidental selfing. No germination was observed in other crosses.

89. Polyploid pollen grains in *Helixanthera ligustrina* (Wall.) Dans.

B. M. JOHRI, Delhi

Most of the microsporangia developed normally—the tapetum was glandular, reduction divisions were simultaneous, cytokinesis occurred by furrowing, and the mature pollen grains were triradiate and bi-celled. In a few buds, however, the microspore mother cells failed to undergo meiosis and formation of double restitution nuclei resulted in spherical, uni-nucleate, tetraploid pollen grains. They showed a thick exine, a large nucleus, vacuolated cytoplasm, and starch grains. Multi-nucleate pollen mother cells and pollen grains were frequently observed. Irregular meiosis, failure of cytokinesis or incomplete quadripartition gave rise to numerous other abnormalities. Polyspory was quite common and some of the spores were multi-nucleate. Two of the polyploid pollen grains had germinated *in situ* and the tubes contained 2 and 6 nuclei respectively.

In the microsporangia under reference, the tapetum was very active. Large crystals had appeared in the cells which, along with the nuclei, had enlarged considerably. Their protoplast was vacuolated and had migrated in between the abnormal mother cells, dyads, tetrads, polyads and polyploid pollen grains. In some of these, the original wall of the mother cell and the special mucilaginous wall was often intact.

90. The morphogenetic effect of some hormones and other chemicals on gemmae of *Tetraphis* (Georgia) *pellucida* Rabenh.

S. NARAYANASWAMI, Delhi

Gemmae of the moss plant *Tetraphis pellucida* have been treated with different hormones like IAA and IBA and with colchicine, sodium cacodylate etc., in White's medium of mineral elements, using the sand culture technique, in order to study the morphogenetic effects of the various test solutions. Growth in White's buffered solution was normal and, therefore, was used as control. Weak solutions of IAA and IBA and other hormones did not produce any appreciable effect and higher concentrations inhibited germination of gemmae. Gemmae that had begun to germinate in White's solution were taken out and grown in hormone media. The filamentous protonemata originating from the nematogones were short and segmented. The formation of thallose protonemata was long delayed or inhibited. Abnormalities like accessory thallose protonemata, formation of clusters of gemmae from upper surface of the parent gemma, fragmentation of the filamentous protonemata, proliferation of single-celled bodies akin to brood cells etc., have been recorded. Similar results have been obtained with 2, 4-D, P-chlorophenxy acetic and α -o-chlorophenoxypionic acids. Cultures with ammonium nitrate caused a remarkable increase in size of the thallose protonemata. With colchicine the normal organisation and growth of gemmae were considerably affected resulting in the formation of varied morphological patterns.

91. A spontaneously occurring variegated chimaera in *Dianthus chinensis* L.

C. M. BASTIA and G. PANIGRAHI, Cuttack.

Spontaneous occurrence of variegated chimaera involved one capitulum of *Dahlia* sp., parts of two of the leaves of *Helianthus annuus* and branches, leaves and flowers of *Dianthus chinensis*, grown for horticultural purposes in the Departmental Botanical Garden. Here, a detailed study of the chimaera in *Dianthus chinensis* is reported.

Of the nine branches arising in a cluster from one seedling of *D. chinensis*, only one branch developed this variegation. It first appeared as a small albino streak near the first node, but it gradually widened its breadth and became conspicuous towards the apex. The sectorial chimaeral branch produced branchlets, leaves and flowers of three categories: (a) all parts green, (b) partly green and partly albino, and (c) all parts albino, the three types arising in strict conformity with their respective points of origin.

Flowers borne on pure albino and normal green branches were selfed and seeds collected. Although 95% of the pollen grains stained red with acetocarmine there was significant reduction in the seed set in the albino flowers.

The branches developed sectorial, mericlinal, pure albino and pure green chimaeral pattern in the matter of development of chloroplasts in the hypodermis. The albino sectors of leaves lacked chloroplasts in the palisade and spongy tissues.

It is suggested that the variegated chimaera in the three species arose spontaneously as 'sports' or bud mutations, induced by environmental conditions.

92. The Problem of the *Aleuritopteris farinosa* complex.

G. PANIGRAHI, Cuttack.

A portion of the *Aleuritopteris farinosa* (Forsk.) Fee complex has been shown to consist of one diploid, one amphidiploid and one triploid, of which the first two

are sexual species and the third, an apogamous species. The analysis of triploid F_1 hybrids between the two sexual species, shows that the diploid, *A. grisea*, though sympatric, is not ancestral to the tetraploid, *A. anceps*. The pentaploid hybrid between *A. anceps* and the apogamous triploid, *A. farinosa* (sensu stricto), shows not only cytological proof of the inheritance of apogamy from the male parent but also the operation of complementary factor system by producing golden yellow powder in the under surfaces of fronds. Further, the relative infertility of the pentaploid hybrid established its parents, *A. anceps* and *A. farinosa*, as two taxonomic species.

It appears that yellow-powdered forms of *A. farinosa* (sensu lato) occur in the wild and have been collected from Victoria Falls in tropical Africa and have apparently good spores. Viable spores of these wild plants with yellow powder should be collected and sown. If their prothalli do not develop archegonia but produce apogamous pentaploid sporophytes, their parentage would have been established. In that case, the pentaploid hybrid between *A. anceps* and *A. farinosa* would have solved a long-standing problem of taxonomy in this species complex.

93. Comparative study of Diploid and Tetraploid Cowpea.

NIRAD K. SEN and M. N. HARI, Kharagpur.

Progenies of a colchicine induced tetraploid Cowpea were found to breed true. Compared to the diploids, though there was not much difference in the size of the seeds, the tetraploids were slow growing, with thicker stems and leaves, late flowering, most of which were shed off. All the floral parts were larger but the pods were smaller with fewer seeds. Pollen sterility and fruit setting were variable among the progenies. Yield of fodder at different stages of growth was less in the tetraploids, which however grows for a longer period. Variability in the growth rate among the tetraploid population is being utilized in selection of a better fodder type.

94. Genetics of Green Gram (*Phaseolus Aureus*, L.)

NIRAD K. SEN and A. K. GHOSH, Kharagpur.

The plants with green, greenish yellow, yellow and bluish black seeds on crossing with one another gives in F_1 , yellowish green (green \times greenish yellow), green (green \times yellow) blue mottling (green \times bluish black) and green (yellow \times bluish black). Rough surface on seed is often dominant over smooth surface but in several crosses between smooth seeds, F_1 were rough seeded. In size, F_1 seeds are intermediate. Crosses between purple \times green hypocotyl and purple \times green with bluish purple spots on hypocotyl gives, purple hypocotyl in F_1 . In epicotyl, purple spots is dominant over green. Heavy purple spots on the petiole of the first pair is dominant over green. Lobed margin of leaf is dominant over entire. Purple rachis of the leaf is dominant over green. Segregation of two characters affecting the margin of lamina and color of rachis are independently inherited, segregating in 9:3:3:1 ratio. Yellowish grey standard is dominant over lavender color of the standard. Purple color on the suture of the immature fruit is dominant over green.

95. Chromosome number of some desert grasses.

B. N. MULAY and M. K. PRASAD.

1. The somatic chromosome numbers of the plants *Digitaria adscendens*, *Brachiaria ramosa*, *Cenchrus plicuri* and *Eragrostis tremula*, are investigated for the first time. They are 60, 36, 34 and 30 respectively.

2. The morphology of the chromosomes of the above mentioned species is studied.

3. The chromosome numbers are compared with the chromosome numbers of the related species.

96. Morphology and number of chromosomes in some desert grasses.

B. N. MULAY and D. JAGDISAN, Pilani (Rajasthan).

1. The present study deals with the chromosome number and morphology in *Cenchrus biflorus* Roxb., *Cymbopogon parkeri* Stapf. *Eragrostis poaeoides* P. Beav. and *Panicum antidotale* Retz.

2. The somatic chromosome number of *Cenchrus biflorus* as investigated is 34.

3. The somatic chromosome number of *Cymbopogon parkeri* is determined as 30.

4. *Eragrostis poaeoides* shows a somatic number of chromosome as 30.

5. In *Panicum antidotale* the diploid number of chromosome is 18.

6. The chromosome numbers are compared with the chromosome numbers of the related species.

97. Chromosome numbers of some desert grasses.

B. N. MULAY and Miss P. PONNAMA, Pilani (Rajasthan).

1. The chromosome numbers of the grasses, *Saccharum munja*, and *Dactyloctenium aegypticum* are studied.

2. *Saccharum munja* showed the numbers 20 and 40 in meiosis and mitosis respectively.

3. Two ecotypes of *Dactyloctenium aegypticum* showed the chromosomes 36 and 24 in somatic divisions.

4. Morphology of the chromosomes of the above mentioned species is determined.

5. A comparison is made of these chromosomes and the chromosome numbers already known.

98. Further studies in the vernalization of the cuttings of plants.

T. C. N. SINGH, Annamalaiagar.

It has already been shown by the author (*Proc. Indian Sci. Congress*, 1955, p. 256) that stem cuttings, of *Ipomoea batatas* Lamk. (sweet-potato) could be successfully vernalized at a temperature of 7°C.; and that the general performance and tuber-yield from these experimental cuttings were far superior to the control. Further experiments on the stem-cuttings obtained from the experimental sweet-potato plants under field-trial in the second and also even in the third vegetative generations, without any low temperature treatment whatsoever, have continued to be superior in their vegetative performance as well as in tuber-yield as compared to the plants raised from stem-cuttings in their second and third vegetative generations of the control.

This experiment was also extended to the clones of *Bryophyllum calycinum* Salisb. by vernalizing cuttings in kelvinator at a temperature of 7°C. for a period ranging from 7 to 14 days. It has been found under pot-culture that the best performance of general vegetative growth and production of leaves both in size and number, has been observed in the cuttings vernalized for 14 days.

99. On the occurrence of two types of heterochromatin in plant nuclei.

S. S. BHATTACHARJYA, Calcutta.

In an experiment of X-ray effects on nuclei with different heterochromatic patterns, several plant species of *Impatiens* were investigated. In the resting nuclei of *Impatiens balsamina* 14 heterochromatic pieces, corresponding to the 14 somatic chromosomes, could be clearly seen. These heterochromatic bodies appeared as dumb-bell shaped, cylindrical structures. In another species, *Impatiens Sultani*, the chromosome number is $2n=16$, but in the resting nuclei more than 40 heterochromatic bodies of round, elliptical or cylindrical shapes could be observed. They were smaller in size and were also less stained than the heterochromatic pieces of *balsamina* chromosomes.

To obtain a better picture Pachytene chromosomes of the pollen mother cells of the two species were studied with ordinary as well as phase-contrast microscopes. In the pachytene stage the heterochromatic chromomeres were differentiated from the euchromatic chromomeres by their greater stainability and bigger size. Between themselves, the two investigated species again differed in the morphological appearance of their macrochromomeres. Where as in *I. balsamina* the heterochromomeres were slightly shorter in diameter and more compact, those of *I. Sultani* were of a larger diameter and comparatively distinct and separated from each other. A significant feature was the presence of a translucent vesicular structure in the middle of the macrochromomeres of *I. Sultani* chromosomes. Heitz (1934), Poulson and Metz (1938), Hannah (1951) and others have reported from time to time the probability of occurrence of more than one type of heterochromatin in the *Drosophila* chromosomes. The study of *Impatiens* chromosomes leads to prove the presence of different types of heterochromatin in plant nuclei. A subsequent X-ray investigation have proved their physical and physiological differences as well.

(x) Palaeobotany

100. On the Fossils of Neiveli-II (Ecological).

(Miss) K. MATHEW, Annamalainagar.

This study deals with the descriptions of four different kinds of mummified leaf cuticles belonging to four distinct species of plants found in the folds of the fragile lignite from Neiveli (S. Arcot district, Madras State). The mesophyll has not been found preserved in any of them. But there is an excellent representation of their adaxial and abaxial cuticular surfaces.

One of them, specimen I is devoid of stomata, cell-walls are thin with loose sinuosity, in shape the cells are broadly rectangular. There is no difference in the general form, shape and structure of the lower and upper surfaces. These characters suggests that the plant having a cuticle of this nature must have been a submerged one.

In specimen II, there is a very wide difference between the upper and lower surfaces of the cuticles and in addition the stomata are restricted to the lower surface only. The shape of the cells of the upper surface are polygonal and those of the lower surface are rectangular. The number of stomata per unit area is three. The subsidiary cells around the stomata are strictly two.

In specimen III the structures of the upper and lower surface are similar with this difference that the stomata are restricted to the lower surface only. The cells are polygonal and are thick walled and there are certain peculiar thickening like

projections at the angles of the cells. The number of stomata per unit area is nine. The number of subsidiary cells around the stomata is two.

In specimen IV also the structure of the upper and lower surface is identical, with stomata restricted to the lower surface only. The cells are polygonal of various sizes. Unicellular epidermal hairs are present in profusion on both surfaces. The number of stomata per unit area is sixteen. The number of subsidiary cells is variable and is four to six.

Arguments have been advanced that the cuticles represented by specimens II to IV also must have belonged to aquatic plants.

(xi) Physiology.

101. Osmotic Gradient.

A. S. MEHTA, Patna.

Osmotic pressure determinations of the cell sap expressed from mature leaves of *Pothos aureus* at different levels of insertion on the stem were carried out cryoscopically by using Beckmann thermometer. A table was prepared indicating the height of insertion of the leaf on the stem and the corresponding osmotic value. A graph was plotted on the basis of this table. The graph and the table clearly indicate the existence of an osmotic gradient from the base to the top of the plant.

102. Physiological studies on the growth of *Hibiscus cannabinus* and *Hibiscus sabdariffa* var. *altissima* with reference to the formation of certain growth components.

B. K. KAR and B. K. DE SARKAR, Barrackpore.

Detailed investigations were undertaken to study the nature of growth and fibre production in *Hibiscus cannabinus* (Mesta) and *Hibiscus sabdariffa* var. *altissima* (Roselle), the two bast fibre producing crops next in importance to *Corchorus* sp. (Jute) in India. The nature of their growth is like that of jute and the yield of fibre is dependent upon the formations of certain growth components like bark, wood and pure fibre during its vegetative growth. The variations of the above components during different growth phases and also their distribution along the stem have been studied. The results showed that the maximum dry matter was found always in the basal regions, in both the varieties—mesta and roselle. The total crude bark formation in early period of growth was found to be greater in mesta than in roselle, but during the later stages of growth roselle recorded a greater quantity of bark formation. The growth of wood was slower in early periods but it gave maximum values in the later stages.

The percentage variation of pure fibre yield in terms of crude bark in mesta in early stages varied from 42 to 51 per cent and later increased to 65 per cent in the flowering period but with the onset of pod stage the percentage formation of fibre decreased.

Roselle which is a crop of longer duration than mesta, gave a very low value of fibre yield in the early vegetative stage varying from 36 to 50 per cent which increased to 50 to 58 per cent at the flowering time, in terms of bark weight.

103. The Organization of the Contractile cell in plant pulvini with special reference to *Mimosa Pudica* Linn.

(MRS.) MRIDULA DATTA, Calcutta.

The cell represents the unit of contractility in motor tissue. The specialized cell walls are modified for extensibility and the protoplasm of the motile cells is made up of the following components viz. cytoplasm, plastids, nucleus, mitochondria, Golgi bodies, some crystalline inclusions and two types of vacuoles. The vacuolar system is highly contractile. There occur a variable number of small vacuoles in the cytoplasm which have a colloidal content, but are free of tannin. The bulk of the cell is taken up by the central contractile vacuole, the size of which in the "resting" state reduces the cytoplasm to a limiting layer. This larger vacuole in the different cells contains tannin in varying amounts. The tannin may be evenly dispersed throughout the vacuole, or as is more usual, may be condensed in a large visible viscous highly light refractive mass. The tannin compounds are found to be in the colloidal state, but the rest of the vacuole is taken up by salts in solution. The large vacuole may be induced to contract or expand by certain agents, whereupon it can be made out that during movement the included tannin matter remains the same in bulk while the highly extensible vacuolar membrane closes round it. The solutes pass out of the contracting vacuole at stimulation, and later after recovery, these solutes are reabsorbed. The vacuole regains its former size, filling up the bulk of the cell.

This type of cell organization with certain variations, holds true for all types of motile pulvini. It is generally observed that the quantity of included tannin is greater in the more active organs and progressively less in the slower moving organs. This tannin matter is rounded up into a mass in the case of *M. pudica*, *B. sensitivum* and *M. spegazzinii*, it occurs in several small masses in *A. carambola*, and in the case of autonomic pulvini such as those of *D. gyrans* and *O. repens* the tannin remains evenly distributed in the vacuolar sap; in large amounts in *D. gyrans*, but in barely preceptible amounts in the case of *O. repens*.

Vacuolar tannin is not found in the case of non-motile pulvini.

104. Effect of Vitamins and Amino-acids on Growth Elongation of Pollen Tubes of Madonna Lily (*Lilium candidum*).

B. SEN and GYANENDRA VERMA, Almora.

The effect of incorporating optimum micro-concentrations of Vitamins B₁ (Thiamine hydrochloride), B₂ (Riboflavin), B₃ (Nicotinic acid), B₆ (Pyridoxine), Vit. C (Ascorbic acid), Inositol (Cyclohexane-hexol) and amino acids dl-methionine, l-proline, dl-lysine (monohydrochloride) and dl-tryptophane on the growth elongation of pollen grains of Madonna Lily (*Lilium candidum*) were observed.

Pollen grains thoroughly washed in 12.5% pure sucrose solution (control germinating medium) to remove all adhering substances were used. The optimum stimulating concentrations of the Vitamins in germinating medium which gave maximum elongation of pollen tubes were found to be Vit. B₁, 1 p.p.m., Vit. B₂ 2.5 p.p.m., Vit. B₃ 0.25 p.p.m., Vit. B₆ 1.0 p.p.m., Inositol 10 p.p.m., Vit. C 0.25 p.p.m. and of amino acids—dl-methionine 30 p.p.m., l-proline 2.5 p.p.m., dl-lysine 7.5 p.p.m. and dl-tryptophane 5 p.p.m.

The comparative elongation of pollen tubes induced in 24 hours by these optimum stimulating concentrations were :

VITAMINS—Control 1271 microns, Vit. B₁ 2206 microns, Vit. B₂ 1492 microns, Vit. B₃ 2478 microns, Vit. B₆ 1966 microns, Vit. C 1347 microns, Inositol 1916 microns.

AMINO-ACIDS—Control 874 microns, dl-methionine 1085 microns, l-proline 1408 microns, dl-lysine 2144 microns, dl-tryptophane 1515 microns.

This study was undertaken in connection with the Indian Council of Agricultural Research Scheme of Plant Physiology and Cytology.

105. Amino-acid Content of the Dust Adhering to Pollen Grains of Madonna Lily (*Lilium candidum*).

GYANENDRA VERMA and D. K. VERMA, Almora, U.P.

Earlier (1951), it was shown that there are unidentified growth stimulating substances in the pollen dust adhering to the pollen grains of Madonna Lily (*Lilium candidum*) inasmuch as the growth of pollen tubes from grains washed in 12.56% sucrose was less than that from unwashed pollen grains.

Pollen grains were washed in 80% ethanol and the amino acid contents of the washings and the washed grains were determined by paper chromatography technique. It was found that at least 12 amino-acids are present in the washings of the pollen grains. Some of the amino-acids found in the washings, viz., dl-aspartic acid, dl-serine, l-glycine, taurine, citrulline and dl-tryptophane were not found in the pollen grains. On the other hand, dl-threonine and l (-) tyrosine were present only in the pollen grains and not in the washings. In general, the individual amino-acid content of the pollen grains were higher, but dl-alanine, l-histidine and dl-lysine were found to be as much in the washings as in the washed grains.

Experiments to identify other growth promoting substances in the pollen washings, viz., major and micro elements hormones and vitamins are in progress.

This study was undertaken in connection with the scheme of Plant Physiology and Cytology financed by the Indian Council of Agricultural Research, New Delhi.

106. Indole-acetic Acid Contents of Control and Vernalised Seeds and Seedlings of Mustard T. 102.

B. SEN and D. K. VERMA, Almora.

Experiments were undertaken to find out whether there was a difference in the auxin contents of control and vernalised seeds and seedlings of mustard T. 102 and also to see the effect of increased period of chilling on the auxin content of the seedling.

Powdered control and vernalised seeds and mascerated 5-day old seedlings of mustard T. 102 were extracted with glass distilled water.

Colorimetric method of Gordon and Waber (1951) was used. The extracts of plant materials were compared with similarly treated standard solution of pure indole-3-acetic acid by Klett's colorimeter and from the ratio observed, the IAA content was estimated.

It was found that the indole-3-acetic acid contents of chilled seeds and seedlings from chilled seeds were greater than those from corresponding untreated material. Furthermore, the IAA contents of seedlings from chilled seeds increased with increased dose of chilling.

Experiments are in progress to find out whether the increase in IAA content of seeds in the process of chilling can be correlated with induced vernalisation of seeds.

These investigations were undertaken in connection with the scheme of Plant Physiology and Cytology financed by the Indian Council of Agricultural Research, New Delhi.

107. Amino-acid contents of Coleoptiles and Growing Tips of Vernalised and Untreated Wheat and Barley.

B. SEN and D. K. VERMA, Almora.

Amino-acid contents of coleoptiles and growing tips of vernalised and untreated wheat Atlas—50 and Barley C. 293, T. 5 and Colonial were determined by using circular, ascending and descending paper chromatography techniques for circular paper chromatography Giri's method (1951) and for ascending chromatography Williams and Kirby's method (1948) were used. Water extracts of the material were prepared following the technique of Richard, Raymond and Gunter (1952).

Butanol, acetic acid and water (40:10:50) was used as solvent, and 0.4% solution of ninhydrin in 95% acetone was used as colour reagent. The chromatograms were developed twice in every case.

Thirteen different spots representing 19 amino-acids were identified in wheat seeds and 10 spots of 20 amino-acids in the coleoptiles of Barley. An estimate of the concentration of amino-acids was made both by measuring the area of the individual spots and by comparing the intensity of colour.

The chromatograms made from the coleoptiles of C and V seedlings of Atlas—50 wheat and C. 293, T. 5 and Colonial Barley showed more Proline in the vernalised material than in the controls. Proline content was found to be higher also in the growing tips from 45 and 66 days old vernalised plants of Colonial barley. Proline content of vernalised coleoptiles was found to diminish during storage. The experimental data presented indicate that one of the effects of chilling wheat and barley seeds is to increase the Proline contents. Further work with different vernalisable seeds is in progress.

These investigations were carried out in connection with the Scheme of Plant Physiology and Cytology, financed by the I.C.A.R.

108. Tracer Studies in sulphur metabolism in plants.

B. B. BISWAS and S. P. SEN, Calcutta.

Using S^{35} labelled Na_2SO_4 two aspects of sulphur metabolism in plants have been studied: (i) the path of sulphate reduction in green plants and (ii) photosynthesis.

Path of sulphate reduction: Roots and leaves of 7-9 days old pea seedlings were kept immersed in a phosphate buffer solution pH 6.0 containing 200-400 μ C of $Na_2S^{35}O_4$ for 1, 2.5, 5 and 15 minutes. They were then killed and extracted in boiling 80% ethanol, concentrated to a small volume and applied at a corners of Whatman No. 1 filter papers. The papers were chromatographed two dimensionally with phenol-water and butanol-acetic acid-water (4:1:1) as the developing solvents. The dried papers were then exposed to Ilford X-ray films for two weeks, the radioactive spots cut out and activities determined with a large window scintillation β -counter. 1 minute was enough for label to appear in taurine, other compounds are formed with increase in time. The path of sulphate reduction in roots and leaves appears to be the same.

Photosynthesis: 6, 8-thioctic acid, the prosthetic group of pyruvic oxidase has been implicated recently as a key compound in photosynthesis, the disulphide form determining the distribution of fixed CO_2 into Krebs cycle acids in darkness, and the reduced dithiol form that into the direct photosynthetic products like sucrose in light. In order to study whether such interconversion actually takes place in light and darkness cells of *Chlorella pyrenoidosa* were allowed to metabolise $Na_2S^{35}O_4$ in light for 4 hours in 4 hours of light followed by 4 hours of darkness and 4 hours of darkness alone, Label was detected in some 40 compounds,

the most interesting being one having high R_f values in both the solvents and possessing high radioactivity. The most striking change was observed in the benzene extracts of H_2SO_4 hydrolysis products. A compound of R_f values 0.19 in phenol water and 0.81 in butanol acetic acid water was detected only in light; another compound of an R_f value 0.63 in phenol water and 0.82 in butonal acetic acid water was found only in darkness.

109. Amino acid metabolism of an antifungal *Streptomyces*.

A. K. BANERJEE and P. N. NANDI, Calcutta.

Results of nutritional studies on a strain of *Streptomyces* (Ac₂48) had been reported earlier (Proc. Ind. Sci. Cong., 1955). The present paper communicates the results obtained from a study on the amino acid metabolism of the organism.

The organism was found to thrive well on a complex organic medium containing beef-extract and peptone as sources of nitrogen. The medium in its final stage after autoclaving was composed of the following amino acids as indicated by two-dimensional paper chromatography (Whatman No. 1) using phenol-water and n-butanol-acetic acid-water (4:1:1) as the developing solvents: aspartic, glutamic, serine, α -alanine, β -alanine, γ -amino butyric, valine, phenylalanine, leucine, arginine, histidine and three other ninhydrin positive substances. On growing the organism in shake flasks for a period of 6 days at 28°C, most of the amino acids registered a steady decline, apparently indicating utilization from the medium.

The quantitative estimation of the individual amino acids originally present in the medium by the elution technique indicated that while the three comparatively low R_f amino acids, viz. aspartic, glutamic and serine behaved rather anomalously regarding their disappearance from the medium, all the others were fairly steadily utilised. Moreover, two new ninhydrin positive substances originally absent in the medium appeared at the end of 48 hours' growth, apparently excreted by the mycelium. One of these substances were identified as lysine. The concentration of these two substances gradually increased with incubation.

Total nitrogen content per unit volume of the medium as determined by micro Kjeldahl technique showed a gradual decrease corresponding to the fall in amino acid contents. The ammonium-nitrogen content, on the other hand, remained more or less unchanged.

110. Role of certain 'B' vitamins on the rooting response of some stem cuttings with distinctive anatomy.

B. SAMANTARAI and R. PATTNAIK, Cuttack.

Twigs of *Boerhaavia diffusa*, a dicot plant with abnormal anatomical structure and *Dracaena angustifolia*, a monocot plant having abnormal secondary growth were treated with β -indolyl butyric acid (I.B.A.), aneurine hydrochloride, nicotinic acid and mixture of these. It was found out that roots from the stem cuttings of *Boerhaavia diffusa* and *Dracaena angustifolia* emerged, earlier, in greater number and in greater length in a mixture of I.B.A., aneurine hydrochloride and nicotinic acid in aqueous solutions. The percentage of cuttings that produced roots was also greater in this mixture. In the formation of roots from cuttings, three stages viz., conversion of permanent tissue to meristems, organisation of meristem to root primordia and the growth of root primordia was recognised. While the hormones are responsible for the first process, it is suggested that accessory food factors like the 'B' vitamins are necessary for the second and third stages.

111. Responses of isolated leaves of *Basella alba* to β -indolyl butyric acid.

B. SAMANTARAI and S. K. SINHA, Cuttack.

The investigation presents threefold responses of isolated leaves of *Basella alba* to β -indolyl butyric acid (I.B.A.) viz., (1) its rooting response, (2) its anatomical response in the form of secondary growth when planted in soil and (3) the expansion of the lamina.

The leaves were treated in various concentrations of aqueous solutions of I.B.A. for 24 hours and subsequently kept in tap water. Roots emerged out of the petioles and the optimal concentration of the hormone was found to be 10 parts per million (p.p.m.). Roots came out through the epidermis but under lower concentrations they emerged through the pith. A week after treatment the leaves were planted in soil and it was found that anomalous secondary growth took place in the petiole and the veins whereas no secondary growth was found in leaves of the same age attached to the plant. Expansion of lamina and longevity of these leaves were much more than those in the attached leaves.

112. Rooting response of isolated tendrils of *Cephalandra indica*.

B. SAMANTARAI and T. KABI, Cuttack.

Rooting has been induced in the isolated tendrils of *Cephalandra indica* by the application of synthetic hormone. The hormone used was β -indolyl butyric acid (I.B.A.). The cut ends of the tendrils were dipped in 50, 20, 10, 5, 2.5 and 0 (untreated) p.p.m. (parts per million) of the substance. The hormone at higher concentrations like 50 and 20 p.p.m. showed toxic effect and the tendrils started rotting from the basal end. Lower concentrations are more effective in root production. The percentage of tendrils rooted, average days from treatment to root emergence, average number of roots per tendril and average length of roots in cm. per tendril were noted. It is found that 5 p.p.m. I.B.A. is the concentration for best rooting in the tendrils of *Cephalandra indica*.

113. Effect of desiccation on the rate of germination of rice grains.

B. SAMANTARAI and A. S. DUBEY, Cuttack.

With a view to inducing drought resistance in rice plants the effect of desiccation on the rate of germination of rice grains was undertaken as a preliminary study. The method consisted in passing a current of air over rice grains after passing through Conc. H_2SO_4 and CaCl_2 . The periods of desiccation was varied such as 24, 48 and 72 hours in different samples of rice grains belonging to varieties viz., CH_2 and N_{136} . It was seen that by this method almost half the moisture of the dry grains were lost and longer the period greater was the loss of moisture. The germination rate which were taken at regular intervals after the date of sowing till the 14th day showed a gradual decline as the period of desiccation increased.

114. Effect of Long Photoperiod on one variety of Early Rice.

G. MISRA, Cuttack.

The effects of 24-hour long photoperiods on one variety of early rice, T.N. 32 (a selection of Baljati of Lucknow district, U.P.) given to 10, 20 and 30-day old seedlings for one month have been studied in pot culture experiments. The treatments at all ages brought about a significant delaying effect in ear emergence.

of the main shoot. Three distinct results are noticed so far as the grain yield is concerned. When the age of the seedlings was 10 days at the time of treatment, the grain yield from those plants was higher than from the controls, whereas when the seeding age was 20 days at commencement of treatment, no difference from the control was noticed. The grain yield was very much reduced when the treatment was given to the 30-day old seedlings. The number of panicles was less in all the treated sets than in the controls. The total number of spikelets and the number of grains per panicle were conspicuously increased in the two sets where the long-day exposure had been given to 10 and 20-day old seedlings. The percentage of grain setting had been favourably affected by the long days.

115. Auxin content of rice plant before and after floral initiation.

S. M. SIRCAR and T. M. DAS, Calcutta.

Morphological changes of the shoot apex of rice var. Rupsail during its transition from vegetative condition to flowering was studied in detail. The successive stages of development have been carefully examined, measured and stated in several conventional units (score) indicative of progress to flowering.

Auxin content of the shoot apex was determined at different stages of development. The auxin of the plant was extracted either by water or by ether at low temperature (4°C) over a long period. Before floral initiation a considerable amount of auxin accumulates in the compact stem (crown); with extension growth, both total quantity and concentration (auxin per gm. wt. of tissue) of auxin in the crown tissue was found to decrease rapidly. Some amount of auxin, however, was left in the crown tissue after termination of stem growth.

In the developing ear a considerable amount of auxin was found to accumulate, the fate of the accumulated auxin was, however, not known.

The auxin content of the nodes and internodes of the stem was found to bear a direct relationship to extension growth of the stem. Young nodes contained much higher concentration of auxin than that present in the internodes; these facts lend support to the assumption that auxin concentration of nodes regulates the extension growth of the stem.

116. Effect of Sodium Sulphate on early seedling growth of gram and wheat.

M. N. SARIN and I. M. RAO, Agra.

Following the technique of Garrard (1954) for studying root-growth in early seedling stage, seeds of gram N.P. 58 (*Cicer arietinum*) and wheat C. 591 were sown at the top of filter-paper rolls fitted into test tubes (filled up to one-third with water or solution), so that the roots could grow vertically downward between the filter-paper and the glass-side. The effect of 0.0%, 0.2%, 0.4%, 0.6% and 0.8% of Na_2SO_4 solutions on root- and plumule-growth was studied daily up to 96 hours after sowing. Twelve replications were maintained and the results were analysed statistically.

Total root-length of wheat was generally greater than that of gram. By the end of 4 days, the root-growth of gram was significantly lowered with each successive increase in the concentration of the Sulphate. In wheat the root-growth was significantly lower even with 0.2% than with water alone; but there was no significant difference in root-growth between 0.4% and 0.6% sulphate solutions or between 0.6% and 0.8% solution, root-length of gram, with 0.8% solution, was only 33.7% and of wheat 89.7%, compared to their controls; with 0.2% solution, the respective root-growths of gram and wheat were 64.3% and 89.7%.

Initially, up to 48 hours after sowing, root-growth in gram was less adversely affected by the salt solution than wheat; the latter improved gradually while gram suffered more and more with continuous supply of the salt solution.

Plumule growth was also affected similarly by the Sulphate solution, gram suffering more than wheat. Thus gram seems to be more susceptible to Sodium Sulphate than wheat.

117. Studies on the effect of Chloride and Sulphate of Sodium on germination, growth and maturity of gram.

S. N. BHARDWAJ and I. M. RAO, Agra.

Relative salt-tolerance of gram (N.P. 58) was investigated in pot culture with two doses of NaCl and Na_2SO_4 (0.05% and 0.1% on air-dry soil) added to the soil. Five replications were maintained for each treatment including the control. Froth eighth to twelfth week after sowing, the plants were subjected to permanent wilting condition four times by stopping watering. A control series with continuous optimum water-supply was also maintained. Observations were recorded on germination, growth at four weekly intervals upto maturity, and also the yield and quality of the seeds.

Germination was not affected by either of the doses of the two salts. Both chloride and sulphate affected growth adversely; chloride affected the shoot-height, while sulphate was more deleterious to leaf and branch number. Under optimum water-supply, shoot-dry-matter was reduced by 17.4% and 6.9% with the two doses (0.05% and 0.1%) of NaCl, and by 34.6% and 48.4% with those of Na_2SO_4 . On the contrary, in plants subjected to soil droughts, as compared to the controls with optimum water-supply throughout, it was reduced by 50.5% and 64.0% with the two doses of NaCl and by 42.6% and 44.4% with those of Na_2SO_4 . Soil drought alone reduced the shoot dry-weight by 31.7%.

Yield could be recorded only for the optimum set. Compared to the control, it was lowered by 29.2% and 31.6% by the two doses of NaCl, and by 49.0% and 55.3% by those of Na_2SO_4 . The quality of seed was affected by the higher doses (0.1%) of the two salts and to a greater extent by Na_2SO_4 .

Sulphate seems to be relatively more toxic to growth of gram than chloride under optimum conditions of water-supply. With soil drought during growth stage (8th to 12th week), relative toxicity of the two salts, NaCl and Na_2SO_4 (particularly the higher dose —0.1%), was reversed; the former salt resulted in a greater depression growth.

118. Effect of Presoaking and Post Treatment with growth regulating substances on Growth, tillering and yield of wheat.

S. K. PILLAI and P. K. P. KURUP, Pilani, Rajasthan.

With the object of determining whether the application of growth regulating substances at various stages of growth of a plant would have any effect in increasing growth, and yield of crop plants, Wheat seeds, *var.* W. 245, were divided into three lots. One was soaked in aqueous solutions of 50 p.p.m. of I.A.A. and Betanaphthoxy Acetic Acid (B-N.A.A.) for 24 hours, after which they were washed well and sown in pots and subsequently treated at weekly intervals with the solutions as the plants were growing up. Another lot was sown directly in pots and after germination treated with the solutions at weekly intervals. A third set was kept as untreated controls. Growth in height, and leaf tiller production were noted at fortnightly intervals and the length of the vegetative period and yield of grains and straw at the end.

It was found that the treatments did not result in any pronounced difference in the vegetative growth as measured by height and weight of straw over the controls. The plants from seeds pretreated with BNAA had alone a longer vegetative period. Presoaking treatments had increased leaf and tiller production, while post treatment had no significant effect. Only in the case of post treatment with BNAA was any significant increase in the production of grains and straw noticed.

119. Effect of presoaking seeds with Beta-Naphthoxy Acetic Acid on the growth of the radicles or roots and coleoptiles or plumules of some cereals and pulses.

S. K. PILLAI and P. K. P. KURUP, Pilani, Rajasthan.

Unsterilised seeds of 4 cereals, Wheat, Barley, Sorghum and Ragi and 2 pulses, *Phaseolus recordianus* and Gram, were soaked for 24 hours in aqueous solutions of Beta-Naphthoxy Acetic Acid of 10, 20, 50, 100, 500 and 1,000 p.p.m. concentrations. Untreated controls were soaked in distilled water. After treatment the seeds were washed well in distilled water and spread out on moist blotting paper in petri dishes and the length of the longest fibrous root and coleoptile or plumule, if it had come out, in the case of monocots and those of the radicle and plumule in the case of the dicots was measured on the fifth day, 10 seeds being used for each treatment and the results statistically analysed.

The acid was found to have a promoting action on the cereals and in the pulses an inhibiting action was noticed, particularly on the plumules. Lower concentrations were found to promote growth in general while higher concentrations were progressively inhibiting.

In the pulses, the hypocotyl was very much swollen in most of the treatments with higher concentrations and this was accompanied by the appearance of longitudinal fissures at very high concentrations. This swelling was found to be due to greater absorption of water and consequent extension of the walls which disappeared when fixed in F.A.A. and dehydrated. The acid seems to promote extension growth along the long axis at lower concentrations and along the broad axis at higher ones.

Unlike other cereals in Ragi the growth of both the roots and plumules was inhibited and the changes in the concentration do not seem to have any consistent reaction. This seems to be an indifferent type.

The plumules of *Phaseolus* were found to be very susceptible to the action of this acid and its growth was progressively retarded with increasing concentration and completely inhibited at the highest two concentrations used.

120. Growth of roots or radicles and coleoptiles or plumules of some cereals and pulses as affected by presoaking seeds with 3-Indolyl Acetic Acid.

S. K. PILLAI and P. K. P. KURUP, Pilani (Rajasthan).

Seeds of 4 cereals, Wheat, Sorghum, Barley and Ragi and two pulses, *Phaseolus recordianus* and Gram, were soaked in aqueous solutions of I.A.A. at concentrations of 10, 20, 50, 100, 500 and 1,000 p.p.m. for 24 hours. Untreated controls were soaked in distilled water. After treatment the seeds were washed well and spread out on moist blotting paper in petri dishes, 20 seeds being used for each treatment and the results analysed statistically.

In general, I.A.A. has a promoting action on the growth in length of the radicle or root and the coleoptile or plumule in all the seeds used, lower concentration promoting growth more than the higher ones. Between the root and shoot portions, the former were found to be promoted more than the latter in the five days after treatment. It was found that the promotion of growth of the root or

radicle reached a maximum at a comparatively lower concentration of the acid as compared with that of the coleoptile or plumule. In other words the roots were more susceptible to the action of higher concentrations of the acid and their growth tended to be retarded as the concentration of the acid was raised. In Gram the plumule was found to be very susceptible to the action of this acid and higher concentrations were found to be definitely inhibitive for both radicle and plumule, which was accompanied by swelling of the hypocotyl.

Ragi seeds were found to react in an indifferent manner and seem to be an indifferent type.

121. Studies in the effect of Moon-light on the growth and reproductive phase of plants—Part II.

T. C. N. SINGH, Annamalainagar.

The author has recently shown (*Proceedings Indian Sci. Congress*, 1955, p. 254) that flowering and fruiting were attained much earlier, and at the same time had been more profuse in plants grown in the absence of moon-light than those in its presence. These observations have now been studied in relation to certain economic and ornamental plants e.g. *Bryophyllum*, Tapioca, Hollyhock, Balsam, Sugarcane, Tomato and Zinnia. From the view point of earliness of their reproductive phase, under the response of moon-light, the following three classes have been recognised :

1. Plants positively responsive to moon-light :
Bryophyllum calycinum Salisb.
Manihot utilissima Pohl (tapioca).
Althæa rosea Cav. (hollyhock).
2. Plants negatively responsive to moon-light :
Impatiens balsamina L. (balsam).
Saccharum officinarum L. (sugar cane).
3. Plants neutral to moon-light but responsive in their vegetative performances :
 (a) Vegetative performance superior in moon-light :
Lycopersicum esculentum Mill (tomato).
 (b) Vegetative performance superior in the absence of moon-light :
Zinnia elegans L.

122. On histological changes in plants evoked by musical excitation of violin and veena.

T. C. N. SINGH and (Miss) STELLA PONNIAH, Annamalainagar.

It has already been shown by the authors (Singh and Ponniah, *Proc. Indian Sci. Congress*, 1955, p. 254) that the structure of the leaf of *balsam* and *Mimosa* undergo certain changes under excitation of musical sounds of violin. This line of experiment was, therefore, extended to other plants like telegraph plant, sweet potato and tapioca in addition to *Mimosa* and *balsam*. The seedlings of these plants for purposes of experiment were raised from pure single plant seeds in the case of *Mimosa*, telegraph plant and balsam, and from clones in the case of sweet potato and tapioca.

The musical excitations were carried on separately by playing single note or ragas on violin and veena. It is curious to note that remarkable changes were evoked anatomically in different organs of the plants. They have briefly been described as under :

Mimosa pudica L. (Sensitive plant) : Under excitation of *Bilahari raga* or single note *pa* played on violin, previous finding in respect of the formation of higher

number of stomata per unit area and enhanced length of the palisade cells have been confirmed. Besides, it has been observed that the synthesis of starch, production of roots and formation of bacterial root nodules in the experimental plants are very much more profuse as compared to the control.

Desmodium gyrans DC (telegraph plant) : Under excitation of single note *pa* played on violin the leaflets in the experimental plants have tended to become much thicker than the control. This has been due to the elongation of the palisade cells of the mesophyll to the extent of about 50% over those of the control. The cuticle on the epidermis too has been rendered much thicker.

Impatiens balsamina L. (balsam) : Under the excitation of *Bilahari raga* played on violin in addition to the confirmation of the other anatomical changes already reported previously it was found that the number of chloroplasts in the palisade was much greater in the experimental leaves than those of the control. The production of root had also been very profuse and the bacterial nodules too on them were more vigorous and bigger than those of the control.

Ipomoea batatas Lam. (sweet potato) : Under excitation of *Kara-hara-priya raga* on veena the production of root system in the experimental plants was more profuse, the stele of root had larger number of vessels (to the extent of 100%) per unit area, and even the lumen of the vessels were much bigger in the experimental plants than the control. Besides a very broad zone of the cortex encircling the root stele was heavily packed with starch whereas in a similar comparative zone in the control quantum of starch was very poor.

Manihot utilissima Pohl (tapioca) : Under excitation of *Simhendra Madhyama Raga* played on veena the lamina had grown thicker because of the increase size and greater number of mesophyll cells in the experimental plants. Besides, the accumulation of starch in the ground tissue towards the abaxial (phloem) side of the vascular bundle in the petiole of the experimental was considerably much greater than in the control.

123. Further studies on the germination of seeds of Leguminosae in relation to the evolutionary tendencies of its leaf.

S. KALYANASUNDARAM, Annamalainagar.

These studies comprise of fourteen species of Papilionaceae, seeds of which were obtained from the Royal Botanic Gardens, Kew (England) and from the Botanic Gardens of Lund (Sweden) respectively through the courtesy of Sir Edward Salisbury and Professor A. Müntzing. Intensive observations have been made on the germinating seeds in respect of the ontogenetic development of the leaves.

This study of fourteen foreign species of Papilionaceae lends further support to the view namely that in foliar ontogenetic evolution Papilionaceae is the most primitive and Mimoseae the most advanced, Caesalpinieae occupying an intermediate position. (*Proceedings of the Indian Science Congress Association*, 1955, p. 227).

In majority of these foreign species the first formed leaf of the seedling has an unusually long petiole, a remarkable character which has not been observed in any of the Indian species so far studied.

The present study has further revealed that the adult leaves in the family Papilionaceae is either simple or compound, and when compound the nature of such a compound leaf is imparipinnate with exception of two genera namely *Abrus* and *Sesbania* where the adult leaves are paripinnately compound. On the other hand in Caesalpinieae and also Mimoseae the leaves are paripinnately compound.

From a careful ontogenetic study of *Abrus* it has been brought out that to start with some of the first formed leaves are imparipinnate and the later formed leaves become paripinnate.

Similar state of affairs has been noticed in the case of *Cassia* where the first formed leaves are some times imparipinnate and the adult leaves being paripinnate. These two genera namely *Abrus* and *Cassia* therefore constitute a connecting link between Papilionaceae and Caesalpinieae. A more careful examination of *Sesbania*—which is under investigation may also show an imparipinnate condition of first formed leaf though rarely.

A theory has been developed that imparipinnate compound leaf is more primitive than paripinnate compound leaf and the same has been discussed in the body of the paper.

124. Further studies on Photoperiodism in relation to factorial lights (Tomato).

S. PANNIRSELVAM, Annamalainagar.

Under a new photoperiodic treatment, designated as 'Photoperiodism in relation to factorial lights' it has recently been shown (S. Pannirselvam: *Proceedings of the Indian Science Congress*, 1955) that earliness and lateness in flowering can be brought about by varying the quantum of artificial, morning and evening lights. In the present investigation a universally known neutral photoperiodic plant Tomato (*Lycopersicum esculentum* Mill.) was experimented upon under the scheme of factorial photoperiodism and it has been possible, to bring about lateness and earliness in flowering by this method. The lateness and earliness are of the order of a fortnight as compared to the control. As far as known such a result has not been achieved before and now it has been possible to prove that under the photoperiodic treatments outlined above Tomato should no longer be treated as day neutral.

125. Further studies on the effect of musical sounds on the growth of plants.

(Miss) STELIA PONNIAH, Annamalainagar.

In the present communication four species of plants were experimented upon, two of which namely *Desmodium gyrans* DC (telegraph plant) and *Capsicum annuum* L. (chillies) had been raised from seeds and the other two namely, *Saccharum officinarum* L. (sugar cane) and *Manihot utilissima* Pohl (tapioca) were raised from clones. Musical excitations by playing notes or ragas on Violin, Veena or Sruti Box were carried on for a period of 25 minutes only in the early hours of the morning except *Simhendra Madhyma* Raga on Veena which was played in the evening hours between 5 P.M. and 6 P.M. The results obtained in each species attendant on the aforesaid musical excitations are briefly described as under.

1. *Desmodium gyrans* DC (telegraph plant): Under the excitation of single note *pa* played on Violin the increase in growth in length of branches was 250%, the production of leaf was about 200% and the formation of the pinnae on leaves was more than 200% and the diameter of stem had grown 80% greater than the control.

2. *Capsicum annuum* L. (chillies): Under excitation of *Simhendra Madhyma* Raga played on Veena, the increase in height of the stem was 90%, production of leaves 120%, diameter of stem 50% and formation of fruits 100% higher than the control.

3. *Saccharum officinarum* L. (Sugar cane): Under excitation of single note *pa* played on Violin, the growth in height of the stem was 60%, production of leaves 120%, and formation of tillers 130% higher than the control. On the other

hand under the excitation of *Bhairavi Raga* played on Violin the growth in height of stem was 25%, production of leaves 30% and that of tillers 200% greater than the control; whereas, under the excitation of musical sounds of *sa pa sa* played on Sruti Box the growth in height of stem and production of tillers were 40% and formation of leaves 50% higher than the control.

4. *Manihot utilisima* Pohl (tapioca): Under excitation of *Simhendra Madhyma Raga* played on Veena growth in length of stem was 110%, production of leaves 80%, diameter of the stem 30% greater than the control. In the experimental plants tuber formations had taken place even in the 7th week whereas there was no tuber formation in the control plants.

126. Observations on plants raised from seeds and clones of musically excited plants.

(Miss) STELIA PONNIAH, Annamalainagar.

In the present investigation seeds of musically excited plants *Mimosa*, *Desmodium* and *Petunia* and turions of musically excited plants of *Hydrilla* were collected separately along with their controls in the first generation. In the second generation the seeds and turions of both the control and experimental plants were separately sown and the results obtained therefrom have been presented as under.

Mimosa pudica L. (sensitive plant): The germination of seeds was about 96 hours earlier and number of seeds germinated was about three times greater than that of the control. Plants formed from these seedlings were of particular interest because in the experimental plants, spread was 134%, number of branches 456%, number of leaves 185% and number of inflorescence 720% greater than the control.

Desmodium gyrans DC: In this case also the vigour of germination of seeds was very much superior to the control, attaining a germination percentage as high as about 90 whereas during the same period the germination percentage of the control was 0.

Petunia hybrida L.: In this case as well, the germination was 100% greater than that of the control and the plants produced from these seedlings had the number of branches and leaves about 100% and 150% respectively greater than the control.

Hydrilla verticillata Presl.: The germination of experimental turions was more than 8 weeks earlier and the production of branches therefrom was 400% greater than the control.

These wide differences in the second generation even without any musical excitation appears to be remarkable and therefore the author has now been pursuing the cytological investigation of them.

ECOLOGY

127. Studies in Plant Colonization and Succession in the Botanic Garden at Annamalainagar by Quadrat method—II

K. K. EASWARAN, Annamalainagar.

Special studies of Colonization and Succession by the methods of 'Count', 'List' and 'Area' Quadrats in the Botanic Garden at Annamalainagar were undertaken during the years 1951-'53. The two, Metre-quadrats viz. QI the Permanent and QI (a) the Temporary were studied every fortnight. The temporary quadrat was dug up once in three months and Colonization and ecesis of plants during the three months were noted. The Permanent Quadrat was never disturbed and the

seasonal succession of plants during the changing seasons were noted. The summary of the results are : that the number of species invading the Permanent quadrat were far restricted and only a very few are really successful in colonization and succession. Compared to the Temporary Quadrat, the fluctuation of species in this quadrat was far less. The species *Gisekia pharnecioides* occurring commonly in the temporary quadrat soon after digging never appeared in the permanent quadrat, which fact proved its inability to compete with other species. In the Permanent Quadrat *Rottboellia myurus*, *Daemia extensa*, *Allmania nodiflora* and *Croton sparsiflorus* were found to grow luxuriantly throughout the course of study. Whereas species like *Ipomoea pes-tigridis*, *Acalypha indica*, *Leucas diffusa*, *Leucas aspera*, and *Cynodon dactylus* showed fluctuation in their growth.

The presence of *Rottboellia myurus* close to the fringes and its inability to invade the Temporary Quadrat proved its requirement of more time i.e. more than three months for ecesis and succession. The migration of *Rottboellia* was in circles and its growth was centripetal. Of all the plants in the Permanent quadrat, this grass with its Caespitose and perennial habit was found to be the most successful constituent in competition and succession. Most of the other plants got ousted due to its perennial penetration in the quadrat.

In the Temporary Quadrat the first colonizer was *Mollugo cerviana*, appearing on the 5th or 6th day after digging. It flowered and fructified soon within 20 to 25 days and got dried immediately afterwards. It could not withstand the competition with other species. Next, *Cyperus rotundus*, *Gisekia pharnecioides*, *Merremia tridentata*, *Bulbostylis* sp. *Mollugo disticha*, *Leucas diffusa*, *Oldenlandia umbellata* etc. appeared in this quadrat. *M. disticha* among them was found to be the most successful in succession.

The plants in the Temporary Quadrat showed luxuriant growth and they flowered much earlier than those of the Permanent Quadrat because of the increased soil moisture and easy availability of nutrient salts due to constant digging.

From the observations taken from a large number quadrats situated, both under sun and shade conditions, and basing on the ecesis of different species, they have been classified under three heads viz. (a) Obligate Sun-loving plants, (b) Obligate shade-loving species, (c) the plastic species which have adaptations for both the conditions.

After a gap of two years the same quadrats have been ear-marked for intensive study and further investigation. Now, *Rottboellia* has spread over nearly half of the entire quadrat.

The methods of study adopted, the colonization and fluctuation of species, in the light of the seasonal changes are given in the full Paper.

128. Observations on the effect of biotic factor in colonization and succession of vegetation in the Botanic Garden at Annamalainagar.

R. VENKATARAMANI, Annamalainagar.

Studies in colonization and succession of herbaceous vegetation in the Botanic Garden at Annamalainagar were done by Singh and Venkatesan during the years 1951 to mid-1953 (*Proc. Ind. Sci. Cong.*, 1954, p. 28), by employing the metre-quadrat method. Two quadrats were established in the vegetation; one Permanent which was not at all disturbed in any way and the other temporary which was dug out every three months. Succession, Colonization and Ecesis of the constituents were studied periodically.

The present study has been continued on the very same quadrats which were established in 1951, with this difference that the shade which used to be cast on both the quadrats by the overtopping growth of *Lantana camara* covered by *Daemia extensa* and *Aristolochia indica* has been eliminated by cutting down all these

bushy growths. This little change which has been wrought by the biotic factor has caused a change of very great magnitude in respect of colonization and succession of the constituents.

In the permanent quadrat the floristic composition before the elimination of shade was those of: *Achyranthes aspera*, *Croton sparsiflorus*, *Digitaria marginata*, *Brachiaria ramosa*, *Clitoria ternatea*, *Euphorbia thymifolia*, *Allamania nodiflora*, *Borreria hispida*; and out of these *Croton sparsiflorus* used to be the dominant constituent from June to August while *Digitaria marginata* and *Brachiaria ramosa* were codominant constituents from the month of November to March and *Borreria hispida* acted as a gap-filling dominant during the months of April and May when the other constituents were at their low ebb. Whereas on the other hand after the elimination of shade the species *Digitaria marginata*, *Brachiaria ramosa*, *Clitoria ternatea* and *Euphorbia thymifolia* have been completely ousted and *Boerhaavia diffusa*, *Cyperus rotundus*, *Cynodon dactylon*, *Rottboellia myurus*, *Bauhinia tomentosa*, and *Cassia sophera* have gained entry and *Rottboellia myurus* has become predominantly dominant and it has checked the healthy growth of other species.

In the temporary quadrat, before the elimination of shade, the following species, *Allamania nodiflora*, *Croton sparsiflorus*, *Borreria hispida*, *Euphorbia hirta*, *Tragus biflorus*, *Stachytarpheta indica*, *Phyllanthus niruri*, *Melothria madraspatana* and *Micrococca mercurialis* used to thrive in the quadrat between the intervals of two diggings, out of which the performance of *Leucas aspera*; *Stachytarpheta indica* and *Phyllanthus niruri* used to be very erratic. After the elimination of the shade *Allamania nodiflora*, *Euphorbia hirta*, *Tragus biflorus*, *Leucas aspera*, *Phyllanthus niruri* and *Melothria madraspatana* have disappeared outright from the scene of succession; and *Cyperus rotundus*, *Boerhaavia diffusa*, *Cleome aspera*, *Commelina bengalensis*, *Achyranthes aspera* and *Clitoria ternatea* have been established into the constitution of colonization.

From this study it is clear that the vegetation under study before the elimination of shade had been harbouring constituents of shady vegetation, and after elimination of shade most of the shade-loving species were ousted and were replaced by sun-loving species as for example *Rottboellia myurus*, *Achyranthes aspera*, *Cyperus rotundus*, *Cleome aspera*, *Cynodon dactylon* and *Cassia sophera*.

It is interesting to note that in the shade of some of the trees the sun-loving constituents interact upto the perimeter of the shade they stay there like onlookers with the slogan "Thus far and no further".

129. Studies in Colonization and Succession of plants in Shade and Sun in the Botanic Garden at Annamalainagar.

K. M. MARIMUTHU, Annamalainagar.

This study is based on certain observations on colonization and succession of plants in Shade and Sun in the Botanic Garden of the Annamalai University. The soil under which these experiments were conducted is predominantly sandy loam. The study was restricted in each case to *five-metre-quadrat*. It has been found that after denudation, whether of the Sun-quadrat or of the Shade-quadrat the first colonizers have been *Mollugo disticha* and *Borreria hispida*. The subsequent colonizers surprisingly enough in each case have been absolutely different e.g. the Shade-quadrat is colonized by saplings of *Millingtonia*, *Daemia extensa*, *Aristolochia indica*, *Commelina benghalensis*, *Morinda tinctoria*, *Cassia tora*, *Odina wodier*; whereas the Sun-quadrat is colonized only by *Rottboellia myurus* and *Desmodium biarticulatum*.

In the Shade-quadrat there has been a good deal of competition between the constituents which has resulted in complete elimination of species like *Commelina benghalensis* and *Cassia tora*, *Aristolochia indica* and sapling of *Odina wodier*.

Dacmia extensa is still holding its field, but its growth has been greatly checked and has been dwindling down and same is the case with *Morinda tinctoria*. The two constituents which have successfully been interacting and have been holding co-dominant rank, are *Millingtonia hortensis*, and *Stachytarpheta indica*. Besides the first colonizers *Mollugo hispida* and *Borreria* have been completely wiped out from the quadrat.

On the other hand in the Sun-quadrat at first the first colonizer namely *Borreria hispida* and *Mollugo disticha* had been maintaining dominancy but soon after there was a serial succession of *Rottboellia* and *Desmodium biarticulatum*, and *Mollugo disticha* and *Borreria hispida* were reduced as subordinates. *Rottboellia myrsus*, therefore, continues to be the dominant species in the Sun-quadrat although *Desmodium* holds the second position.

130. Ecological Studies in the undergrowth of Shade Trees.

T. S. PARTHA and R. GANESAN, Annamalaiagar.

A study of the floristic composition of the undergrowth, found in the shade of 22 different species of trees (*Tamarix gallica* L., *Hibiscus tiliaceus* L., *Azadrachta indica*, A. Jus., *Zizyphus jujuba* Lam., *Mangifera indica* L., *Odina woder* Roxb., *Pongamia glabra* Vent., *Cassia fistula* L., *Tamarindus indica* L., *Peltophorum ferrugineum* Benth., *Poinciana regia* Ras., *Parkinsonia aculeata* L., *Acacia arabica* Willd., *Albizia lebbek* Benth., *Prosopis spicigera* L., *Enterolobium saman* Prain., *Eugenia jambolana* Lam., *Morinda tinctoria* Roxb., *Bassia latifolia* Roxb., *Mimusops elengi* L., *Kigelia pinnata* DC., *Ficus bengalensis* L.) has been made in and around Annamalai University campus. A total of 56 species was recorded as constituents of the undergrowth formations, and they are enumerated in the full paper.

It has been found that these trees may be classified according to the nature of their respective undergrowths into (I) *Trees without undergrowth* and (II) *Trees with undergrowth*. Trees with undergrowth can be further classified into (A) *Trees with undergrowth on the fringes of the shade* and (B) *Trees with undergrowth throughout the shade area*. The last one viz. Trees with undergrowth throughout the shade area may further be sub-divided into two types (a) *Trees with herbaceous undergrowth* and (b) *Trees with shrubby undergrowth*.

Certain species are predominantly found under certain tree shades, i.e., *Ruellia prostrata* Poir and *Desmodium triflorum* W. & A. grow as co-dominants under *Enterolobium saman* Prain, and *Acalypha indica* L. grows as dominant under *Bassia latifolia* Roxb. But in other cases such constant dominance of particular species in the undergrowth formation of particular trees has not been observed.

Trees like *Prosopis spicigera* L., *Zizyphus jujuba* Lam. and *Acacia arabica* Willd. are restricted to soil rich in clayey loam, and peculiarly enough they are devoid of any undergrowth.

The fringe formation under trees like *Tamarindus indica* L. and *Mimusops elengi* L. is noteworthy, because the undergrowth constituents grow at the very periphery of the shade like onlookers and surprisingly enough no species is able to have its ecesis in the shade area of the crown.

In the above two cases the absence of undergrowth and the restriction of the growth of constituents to the fringes of the shade may presumably be attributable to harmful toxins secreted by the roots of the trees.

An interesting case of undergrowth was found in *Enterolobium saman* Prain, where the formation had developed into concentric zones, e.g., the inner-most zone about 1 to 2 feet away from the main trunk is constituted of *Ruellia prostrata* Poir., the middle zone of *Desmodium triflorum* W. & A. and outer-most zone of several

species like *Justicia prostrata* Gamb., *Commelina benghalensis* L., *Croton sparsiflorus* Mor.

131. Response of *Eclipta Alba* Linn. To high and low soil moisture.

Miss QAMAR SIDDIQUI, Hyderabad-Deccan.

1. *Eclipta Alba* Linn. shows striking adaptation to marshy, mesophytic and dry habitats in relation to its root system. The plant gives evident responses to high and low soil moisture.

2. High soil moisture inhibits the growth of the tap root and lateral roots while accentuating the growth of adventitious roots. Thus, there is a profuse development of surface feeders that do not penetrate deeper due to excess of moisture and insufficient aeration of the soil. On the other hand *Eclipta Alba* of the dry habitat has a typical tap root system with lateral roots whereas adventitious roots are conspicuous by their absence. Correlated with this type of root system is the deeper penetration in the soil as the latter is comparatively dry and sufficiently aerated.

3. Plants of *Eclipta Alba* have been grown in glass house for 5 months in marshy, mesophytic and dry soils and the following observations have been made.

(a) The plants grown in the moist soil are taller, heavier and the photosynthetic part of the plant is more or less twice heavier than that of the dry soil. But in the latter habitat, the root system is doubly weighty than that of the marshy plant.

(b) In the high soil moisture, the photosynthetic area of the plant is 3.19 times greater than the total root area whereas in the dry soil, the surface area of the shoot system is only 1.53 times greater than the root system. Thus the capacity of the plant to elaborate its root system and at the same time to meet the stress of insufficient moisture by limiting the development of its shoots is especially noteworthy.

(c) In the moist soil, the dry weight ratio of the shoot to root is 12:1 whereas in the dry habitat it is 3:1. Thus plants grown in soil of higher moisture have four times greater dry weight ratio of the shoot to root than the plants of dry soil.

Haasis (1921) and Crist and Stout (1929) also found that the dry weight ratio of the shoot to root is proportional to available soil moisture.

4. The moist soil proved more favourable to the development of surface adventitious roots but the tap root system is far more developed in the dry soil and connected with this is the greater depth of penetration.

The data of the soil analysis, anatomical characters as well as culture experiments clearly indicate that the water content of the soil, the factor consequent on changed moisture is of considerable importance in the response and behaviour of the root system of *Eclipta Alba*.

MISCELLANEOUS

132. Some observations on vegetative propagation in *Tapioca* (*Manihot utilissima*).

B. MISRO and A. MISRA, Bhubaneswar.

Three kinds of seed material (i.e., bottom, middle and top cuttings) and three methods of planting (i.e., horizontal, vertical and slant) were tried on mounds to ascertain factors conducive to easy establishment of cuttings in *Tapioca*. Bottom

cuttings planted slant gave the best results. Neither hormone treatment nor ringing the cuttings near the base resulted in any better establishment.

A peculiar physiological phenomenon was observed. The basal portions of certain shoots that remained under the soil were devoid of chlorophyll and were swollen to such an extent as to be indistinguishable from the normal tuberous roots of Tapioca, both in appearance and taste, indicating that the temporary change of environment of an organ has altered its physiological function.

133 Microflora in crude petroleum.

DEBASHIS BANERJEE, Calcutta.

Seven samples of Crude Petroleum, obtained from the Nahorkottya Wells (Tipam Sandstone stage) Assam, through the courtesy of Mr. Metre of the Assam Oil Co., have been examined for microscopic studies. The present paper is a preliminary report on the results obtained.

A good number of vegetable remains are observed :

1. Cuticular structures—A number of well preserved cuticles are found. Only a few of them show stomata or epidermal appendages. Two grass-like cuticles are also observed. These are very well preserved and show clear stomata.
2. Cellular structures—Many cellular structures have been observed. The fragments are made up of from a few to 8 to 12 or more cells.
3. Spores and pollen—All the samples contain spores, most of which possibly belong to the Pteridophyta. A few fungus spores are also found. The number of pollen is small.
4. Wood fragments—A few fragments of carbonised and semicarbonised wood are found. These fragments are made up of tracheids, or ray-fields with simple and/or bordered pits.

A few fungal hyphae are also observed.

In addition to these a few scales of insects are also found in some of the samples.

An attempt is being made to ascertain the nature of the vegetable source material of the oil. Detailed work on the microflora in these and other samples of oil and rocks from different zones is in progress.

134. Pharmacognostic studies of the plant *Coleus Aromaticus* Benth.

D. D. DATTA and M. D. CHAKRAVARTI, Calcutta.

The plant *Coleus aromaticus*, Benth (Fam.—Labiatae) is a short perennial herb, highly aromatic and cultivated throughout India. The raw juice of the leaves is used in many parts of India for the treatment of urinary diseases, colic, dyspepsia and diarrhoea. During the cholera epidemic of 1953 in Calcutta, the juice of the leaves was found to be of great therapeutic value.

There lies a confusion between the vernacular name of the plant *Bryophyllum pinnatum*, *Coleus aromaticus* and *Pavonia odorata*, even the practitioners of indigenous medicine have confusing ideas about the identity of the plant. The vernacular names—*Patharkutchi*, *Patharchur* and *Bala* or *Pashanbheda*, are all applied to denote the above mentioned plant.

To clarify the confusion arising from the common vernacular names of the plant, a pharmacognostic description and important histological characters of the plant are discussed and illustrated.

135. Pharmacognostic investigation of a few species of *Rauwolfia* for finding a new source of the drug.

S. C. DATTA and M. D. CHAKRAVARTI, Calcutta.

Investigations were carried out with different species of *Rauwolfia* in order to find a new source of the drug and the following species, viz., *R. serpentina*, *R. canescens*, *R. hirsuta*, *R. heterophylla*, *R. decurva* and *R. vomitoria* were included in the study.

Microscopic studies revealed that *R. serpentina* is distinct from other species in the presence of storied cork and absence of stone cells and the absence of sclerenchyma in the cortex. *R. densiflora* and *R. decurva* possess stratified cork similar to that of *R. serpentina* but contain sclerenchyma in the cortex as well. The stone cells in *R. densiflora* are much smaller in size than those of *R. decurva*. *R. vomitoria* possesses stone cells similar to those of *R. decurva* but their percentage, and sometimes their size are greater than those of *R. decurva*. *R. heterophylla* resembles *R. hirsuta* and *R. canescens* in histological structure and it is very difficult to separate the three from microscopical observations. *R. hirsuta* is considered by the author as a synonym of *R. canescens*. All the species are used in the preparation of commercial tablets of *Rauwolfia* and can be identified by micro-analysis of the samples, paying particular attention to the size and percentage of stone cells present.

Chemical investigations and pharmacological work showed that *R. hirsuta* could be used profitably as a substitute for *R. serpentina*.

136. Studies on the decomposition of Crag Herbicide and its effect on the soil microflora.

(Miss) M. PURAKAYASTHA and P. NANDI, Calcutta.

It has been observed that the 'Crag' herbicide Sod-2-(2, 4-dichlorophenoxy) ethyl sulphate is converted to 2-(2, 4-dichlorophenoxy) ethanol when in contact with soil. A marked increase in the number of microorganisms, fungi, bacteria and actinomycetes, takes place following the treatment of herbicide. This may be due to the stimulating effect of some decomposition product of the herbicide. No such stimulation, however, is observed in life-less media.

137. Pharmacognosy of stems of *Rauwolfia serpentina* Benth.

B. GUPTA, Calcutta.

The presence of stems in the commercial supply of *Rauwolfia serpentina* roots can not be easily differentiated from the outward appearance. However the stems are very tough when fractured with long projecting bast fibres. The histologic characteristics are: the cork cells are not stratified, starch is absent in the cortical cells and the phloem fibres are numerous and are more than 9 mm. in length. The pith is very large with a large number of interxylary phloem strands, which are found to be 40 or more. The rhizome is intermediate in the histological characters between stem and root. There are many other differences found in the shape and size of other tissues when studied in detail.

138. Some floral abnormalities in *Opuntia dillenii* Haw.

R. N. CHOPRA, Delhi.

The ovary of *Opuntia dillenii* bears photosynthetic leaves with axillary buds, like those on the vegetative shoot. If a flower bud or an immature fruit gets

separated from the plant and falls on moist soil, it produces vegetative shoots and adventitious roots from different areoles. The proliferation of attached flowers giving rise to secondary and tertiary flowers has, however, not been observed (see Johnson, 1918; Rao, 1921).

The author came across some interesting floral abnormalities in plants growing on the New Delhi Ridge. These chiefly belong to two categories : (i) Several stages in the fusion of flowers were observed. In some specimens the lower half, or even three-fourths of the two ovaries was fused, but the ovarian cavities and other floral parts were quite separate. Rarely, the fusion had extended up to the style and stigma resulting in a single large flower. The double nature of such flowers and fruits was, however, quite evident from their size and the presence of almost twice the number of basal spines, areoles, vascular bundles, perianth lobes, stamens and stigmatic lobes. The ovarian cavities also, though partly fused, could be recognised as two entities. (ii) In a normal flower the ovary is obconical but in some cases it had become very much flattened and enlarged and showed a larger number of leaves and areoles. Thus, while the rest of the floral parts were as usual, the ovary resembled a vegetative joint.

The flower of *O. dillenii* retains certain characteristics of the vegetative shoot, such as the occurrence on it of photosynthetic leaves with axillary buds and its capacity for vegetative propagation. The flattened and enlarged ovary of some abnormal flowers may be considered to give a further indication of its axial nature.

SECTION OF ZOOLOGY AND ENTOMOLOGY

President :—DR. M. L. BHATIA, Ph.D., D.Sc., F.N.I., F.Z.S.I., F.Z.S.

Abstracts

(i) Protozoology

1. **Re-examination of *Rickettsia lectularia* Arkwright, Atkin and Bacot, 1921, with a note on the 'mycetome' of the host.**

B. DASGUPTA and H. N. RAY, Calcutta.

Coccoid forms of *Rickettsia lectularia* were detected in bed bugs (*Cimex lectularius columbarius* Jen. and *Cimex lectularius lectularius* L.), collected during the period August-November, in the gut-wall and in some other organs. The nuclear structure of these rickettsians was very slightly Feulgen-positive, while the cytoplasm took up intense pyronin stain. The distribution of polysaccharide and the occurrence of the enzyme alkaline phosphatase were cytochemically demonstrated.

References are cited and detailed discussion made on the problem of intracellular symbiosis in insects. Regarding the mycetomes it is pointed out that it is not quite impossible that these organs are really a pair of ductless glands serving some unknown function.

2. **On *Holomastigotoides rostrata*, a new species of *Hypermastigina* (*Mastigophora*) from the gut of a termite from Lucknow.**

NARSINGH NARAIN, Lucknow.

The body is large and pyriform but without a segmented appearance. The flagella are in spiral rows, and are numerous (15 to 35 rows). A mass of dense cytoplasm surrounds the ovoid nucleus near the anterior end. A rostrum is present at the anterior end, which is short and conical, and bears moderately long flagella on the sides, but not at the anterior end. The size is about 200 μ long and 120 μ wide. The present species resembles *Holomastigotoides hartmanni* Koidzumi in its spiral rows of flagella and the prominent cytoplasm around the ovoid nucleus. But it differs from *H. hartmanni* in possessing a well marked but short flagellated rostrum.

3. **On *Holomastigotoides truncata*, a new species of *Hypermastigina* (*Mastigophora*) from the gut of a termite from Lucknow.**

NARSINGH NARAIN, Lucknow.

The body is large, pyriform and without a segmented appearance, while the spiral rows of flagella are numerous (25 to 40 rows). A mass of dense cytoplasm surrounds the ovoid nucleus near the anterior end. The posterior part of the body is truncated and presents almost a straight edge. The size is about 150 μ long and 100 μ wide. The present species differs from *Holomastigotoides hartmanni* Koidzumi in having the posterior end of the body truncated (in a manner commonly seen in *Opalina*), and in the number of flagellar rows. It differs from *Holomastigotoides rostrata* n.sp. in lacking the rostrum, and in its flagellar rows.

4. Some species of *Hypermastigina* (*Mastigophora*) from the gut of termites from Lucknow.

NARSINGH NARAIN, Lucknow.

A detailed protozoological examination of the gut contents of species of termites from Lucknow revealed the presence of the following species of *Hypermastigina* :—

(1) *Holomastigotoides hartmanni* Koidzumi, (2) *Holomastigotes elongatum* Grassi (3) *Rhynchonympha tarda* Cleveland *et al*, (4) *Rostronympha magna* Duboseq, Grassi and Rose, (5) *Microspirotrichonympha ovalis* (Brown).

Holomastigotoides hartmanni was found by Koidzumi in the gut of *Coptotermes formosanus*, *Holomastigotes elongatum* by Grassi in the gut of *Reticulitermes lucifugus*, *Reticulitermes speratus*, *Reticulitermes flaviceps*, and *Macrohodotermes massambicus*. *Rhynchonympha tarda* was recorded by Cleveland in *Cryptocercus punctulatus*. *Rostronympha magna* was found by Duboseq, Grasse and Rose in the gut of *Acanthotermes ochraceus* of Algier. *Microspirotrichonympha ovalis* was found by Brown in *Reticulitermes flaviceps*. To my knowledge this is the first time that the above mentioned protozoa have been recorded from India in the gut of the termite *Odontotermes assmuthi*.

5. Macronuclear Reorganization in *Lionotus* sp.

P. N. GANAPATI and M. V. NARASIMHA RAO, Waltair.

In *Paramecium aurelia* Diller (1936) describes in addition to autogamy and conjugation, fragmentation of the macronucleus which is not correlated with any special micronuclear activity. He coined the term "Hemixis" to include this type of changes on the part of the macronucleus and believes that it involves a purification act on the part of the macronucleus.

While examining a common sp. of *Lionotus* obtained locally we observed various stages of macronuclear reorganizations which could be interpreted as "Hemixis". Our observations conform to the "D type of Hemixis", in which extreme fragmentation occurs. A new macronuclear anlagen appears in the centre of the individual and rapidly develops into a ribbon-shaped body which divides along with the animal. In each daughter organism another division of the macronucleus results in the formation of two elliptical macronuclei characteristic of the vegetative form. Very often the chromatin bodies in the cytoplasm also seggregate, but they lose their affinity to basic dyes and Feulgen test progressively and disappear totally at a latter stage.

Details are given in the paper with a discussion on the present position of Endomixis.

6. Alkaline tolerance of *Entamoeba invadens* Rhodain.

SIVATOSH MOOKERJEE and H. N. RAY, Calcutta.

The alkaline tolerance level of *Entamoeba invadens* Rhodain is worthy of experimental verification. Interesting results have been obtained to show that the trophic forms of this parasitic protozoa cannot endure the alkalinity of the culture saline beyond the range of pH 11. Tropic forms, when introduced in pH 11 saline, immediately burst and disintegrate. However, at pH 10.5, they show certain protoplasmic reactions. Almost immediately, the trophic forms show slowing down of their movements and gradually round up. Within 30 to 60 minutes, their

plasmalemma becomes so permeable as to allow the extension of some of the cytoplasmic granules. Continued exposure renders the cytoplasm more hyaline and clear and less granular in nature. Cytochemical studies of these forms bring to light a phenomenon of substance-change. The alkaline phosphatase reaction in nucleus as well as in cytoplasm becomes reduced. The basophilia of the protoplasm also become less reactive. However, D.N.A. reaction of the nucleus does not show any proportional reduction.

Continued observation on the alkali treatment of *Entamoeba* shows that physiological activity of the trophic forms may return back after 10 to 20 hours and normal trophic condition may be restored. Experiments are being made to test how far this is cytochemically true.

7. Reactions of Amoebae to Dinitrophenol.

BANSIDHAR HAJRA and SIVATOSH MOOKERJEE, Calcutta.

Effects of dinitrophenol have long been known to be protein-precipitent. Experiments have been made on two species of amoeba viz., *Naegleria gruberi* and *Acanthamoeba* sp., to test the morphogenetic effects of different dilutions of dinitrophenol.

The cystic forms of both the species can resist up to 20% of the dinitrophenol solution in water and regular trophic forms are always available after a sub-culture of the treated cysts.

The trophic forms of the two species show difference as regards their resistance to dinitrophenol. 0.01% dinitrophenol is resistable by *Naegleria*. However this concentration is a lethal dose for *Acanthamoeba* because no sub-culture is possible after such a treatment.

The effects of dinitrophenol on the trophic protoplasm of the two species are best studied by .05% solution. Immediate effects produced on the amoebae are the vigorous inducement of movements. The cytoplasmic nature of the trophic forms becomes changed, loses its granular form and becomes clearer in appearance. The nucleus swells up and a prolonged treatment for two to three hours may round the trophic forms.

It is suspected that the protoplasmic changes brought about by the treatment of dinitrophenol are totally irreversible because the present experiments tend to show that protoplasmic readjustments are possible in the trophic forms if the effects are within the limit of sublethal doses.

8. Effects of temperature on the emergence of Trophic forms in Amoebae

BANSIDHAR HAJRA, Calcutta.

At the time of subculture of amoebae, normal cysts are transferred to the nutrient agar clot and placed in a moist chamber. Instead of using normal water, it has been found that if the filter paper of the moist chamber is soaked with the boiling water, the heat generated in the culture chamber expedites the trophic formation. Observations made after 24 hours on these culture slides, reveal the abundance of trophic forms. A similar experiment with ice-cold water to soak the filter paper of the moist chamber has also been made. The results show that the emergence of trophic forms has been delayed and not until three to four days regular trophic forms come out.

It seems, the thermal exposure and the time-factor in the emergence of trophic forms from cysts are not unrelated factors.

(ii) Coelenterata

9. Seasonal distribution of the Hydromedusae of the Visakhapatnam Coast.

P. N. GANAPATI and R. NAGABHUSHANAM, Waltair.

The paper deals with the Hydromedusae of the coastal waters off Visakhapatnam collected during July, 1951 to June, 1953. 41 species belonging to 34 genera of which 18 are Anthomedusae, 16 Leptomedusae, 4 Trachymedusae and 3 Narcomedusae have been recorded. The seasonal occurrence, maxima and minima of these species and fluctuations in the total population of Hydromedusae have been discussed.

From the beginning of February, the number of Hydromedusae in the plankton showed a steady tendency to increase. By the middle of March it reached its maximum and with slight variation continued to maintain this level till the end of April. From April onwards, there was a slow decrease which tends to a secondary maximum in August. From the beginning of September there was a slow decrease in numbers and in October and November we noticed the lowest intensity for Hydromedusae. A comparison of the distribution of the local forms has been made with similar observations made at other places in India.

(iii) Helminthology.

10. Two New trematodes of the family Allocreadiidae from the fresh-water fishes of U. P.

S. P. GUPTA, Lucknow.

The present work gives a description of two new forms belonging to the family Allocreadidae and the sub-family Allocreadiinae and is in continuation of the contributions already made by the author.

i. *Allocreadium kaushivai* n. sp.

A large number of specimens of these forms were collected from the intestine of a fresh-water fish, *Chela bacaila* obtained from the fish market in 1954 at Lucknow. The new form has vitelline follicles extending up to the posterior margin of oral sucker and differs in this character from all the species of the genus *Allocreadium* Looss, 1900, except *A. pseudotriloni* Rankin, 1937. The new form differs from *A. pseudotriloni* in the presence of a prepharynx, a cirrus pouch anterior to ventral sucker, in the structure of vesicula seminalis and in the position of genital pore.

The new species is named after my former teacher, Dr. B. S. Kaushiva, Lucknow.

ii. *Allocreadium mehri* n. sp.

Seven specimens were collected from the intestine of a fresh-water fish *Rhynchobdella aculeata*, obtained from the fish market in September, 1954, at Lucknow. The new form differs from all the known species of the genus *Allocreadium* Looss, 1900, in the extension of vitelline glands from the level of the ovary up to the hind end of the body except *A. isoporum*. The new form differs from *A. isoporum* in having the ventral sucker larger than oral sucker, in the position of testes, in having a small oesophagus and in the position of genital pore.

The new species is named after Dr. H. R. Mehra, Professor of Zoology at Allahabad University.

In the paper a detailed description of two new species is given.

11. A redescription of *Opisthorchis pedicellata* Verma (1927) and a reconsideration of the validity of *Opisthorchis pedicellata minuta* Mehra (1941).

S. P. GUPTA, Lucknow.

A large number of specimens of this form were collected from the gall bladder of *Rita rita* (Ham.) from the rivers of Jumna and Gomti at Saharanpur and Lucknow respectively. Verma (1927) described *Opisthorchis pedicellata* from *Rita rita* and *Bagarius yarrelli* at Allahabad. Mehra (1941) described *Opisthorchis pedicellata minuta* from *Mystus seenghala* and *Wallago attu* at Allahabad. This sub-species was created on account of the smaller size of the body and in having suckers of equal size. The specimens obtained by the author were fully mature and are intermediate in size of the specimens described by Verma and Mehra and that the size, the extent and relative position of various organs are variations within the species. Hence *Opisthorchis pedicellata* Verma (1927) and *Opisthorchis pedicellata minuta* Mehra (1941) and the form described are the same.

A detailed description of the form is given in the paper.

12. A redescription of *Bucephalopsis magnum* (Verma 1936) Srivastava, 1938.

S. P. GUPTA, Lucknow.

A number of trematodes were collected from the intestine of *Silondia gangetica* (Cuv & Val) from the river Gomti at Lucknow in 1950, in the months of November and December. The specimens resemble closely the forms described by Srivastava and Verma, 1936 and 1938. There are slight variations between the forms described by Verma and Srivastava and of the author's specimens, which require a redescription of the form.

Verma (1936) described 5 new species of the genus *Bucephalopsi* viz., *B. fusiformis*, *B. garuai*, *B. magnum*, *B. confusus* and *B. minimus* from the intestine of fresh-water fishes at Allahabad. Of these the last 3 are in the opinion of Bhalerao, synonym of *B. garuai*. The minor differences pointed out to be existing between the species and the last three can be ascribed either to difference in age or to individual peculiarities. Srivastava (1938) is inclined to accept *B. magnum* Verma 1936 as a valid species but maintains that *B. confusus* Verma 1936, *B. minimus* Verma 1936 are synonymous to *B. garuai* Verma 1936.

I also agree with Nagaty (1937) as in *B. garuai* the bilobed or double nature of the vitelline follicles is unique feature of the species and is not reported to occur in any other Gasterostome.

A detailed description of the form is given in the paper.

13. On a New Metacercaria from the Eyes of a Fresh-water Fish, *Mystus seenghala* (Sykes).

PREMVATI, Lucknow.

A number of metacercariae have been obtained from the vitreous humour of the eyes of a fresh-water fish. They are not encysted forms. The paper describes the anatomy and systematic position of the metacercaria. The nature of the spheroidal bodies is also discussed.

14. Studies on Calcareous Corpuscles in *Taenia saginata*.

A. B. CHOWDHURY, B. DASGUPTA, H. N. RAY, and N. V. BHADURI,
Calcutta.

Numerous well-defined spherical bodies known as calcareous corpuscles are found in the parenchymal region of *Taenia saginata*. These corpuscles are believed

to contain in addition to calcium, an organic base of unknown identity. The present study was made to determine the composition of these calcareous bodies with a view to determine their probable functions.

The presence of calcium in those areas has been confirmed histochemically. Besides, most of these balls contain variable amount of RNA and some of them show the presence of DNA in appreciable quantity. Polysaccharides, viz., glycogen, HAP, and mucopolysaccharide, were detected in these corpuscles. These bodies also contain considerable amount of simple proteins and lipids. Definite alkaline phosphatase activity was detected at these sites. The configuration of these corpuscles reveals a concentric arrangement suggesting their formation in layers.

It is pointed out that the occurrence of the enzyme alkaline phosphatase in association with calcium and glycogen recalls to mind the usual picture of bone-formation in vertebrates. It also appears possible that these corpuscles may act as metabolic pathways, directly or indirectly concerned with phosphorylating glycolysis, the simple storage, transformation and disbursement of proteins and carbohydrates, or may serve as store-house of unutilised food-materials.

15. Effects of Diazinon, Salicylic Acid and Benzoic acid on wheat Nematode.

A. S. SRIVASTAVA and K. P. KATIYAR, Kanpur.

The wheat crop is affected by nematodes of the species *Anguillulina tritici* which are found practically all over the world resulting in the replacement of wheat grains by cockles. Each cockle or wheat-gall contains thousands of larvae of this nematode in a quiescent state. This problem needed a special attention because these galls are fairly common in wheat crop of the western districts in Uttar Pradesh. Research work in the laboratory has revealed a few compounds which have been found to possess killing properties against these nematodes liberated from the galls. Parathion, Malathion, Brilliant Green, DDT, BHC, Benzoic Acid, Salicylic Acid, Diazinon, and others have been tried. Out of these 0.1% Diazinon, 0.03% Benzoic acid and 0.05% Salicylic acid in aqueous solution gave practically complete mortality of these nematodes after 24 hours. These three chemicals appear to be most promising in possessing the toxicity against these nematodes. Further field scale trials are being conducted to confirm this finding.

16. Effects of Diazinon on Paddy nematodes.

A. S. SRIVASTAVA and H. P. SAXENA, Kanpur.

Nematodes are serious pests of crops. But there are not very many chemicals that are known to be effective against them. Laboratory experiments have indicated that Diazinon compound (Basudin), when sprayed on the soil in paddy crop at the concentration of 0.05% emulsion, has proved effective against the nematodes and has completely controlled them within 72 hours, while other insecticides like BHC and DDT have proved ineffective under similar conditions. The residual properties of this compound is under investigation.

17. Schistosomiasis in India.

B. S. CHAUHAN, Calcutta and Y. S. CHAUHAN, Narsinghpur.

The paper deals with both human and animal Schistosomiasis in India. The authors have reviewed and discussed the present systematic position of the repre-

sentatives of the superfamily recorded so far, from India, in the light of experience of their own collections and studies on the group. Diagnosis of the different species and key to their identifications have been given with illustrations. The article is of particular interest in view of the recent record of endemic focus of human schistosomiasis in India by de Sa and Monteiro (1949) from Guhagar village; by Rao, Gadgil and Shah (1952) from Chiplun and Gadgil and Shah (1952) from the Gimvi village, in the Ratnagiri District (Bombay State). A survey of the molluscan fauna of the Gimvi village and the surrounding endemic area was conducted by the Zoological Survey of India, under the senior author and by Shri Ramakrishna, with the help and co-operation of Dr. Gadgil and Shri Daghe of I.C.M.R. The Mollusc collections were determined by Dr. H. C. Ray and reveal the presence of only two types of gastropod molluscs; *Paludomus obesa* (Philippi, 1842)—Family Melanidae and *Ferrissia tenuis* (Bourguignat, 1862)—Family Ancyliidae. The latter species only was, however, found so far, yielding the cercariae, looking like that of the human schistosome, *Schistosoma haematobium* (Bilharz, 1852) Weinland, 1858. Recently Peter and Srivastava (1955) have reported a new larval cercaria, *Cercaria ratnagiriensis* from *Paludomus obesa* from the same area.

Medical and veterinary aspects of the problem have also been touched upon.

(iv) Crustacea

18. Observation on the Structure of the Mouth Parts and the Mechanism of Feeding in *Caridina laevis* (Heller) 1862.

R. SRIDHARAN PILLAI, Travancore.

The structure of the mouth parts and the mechanism of feeding in *Caridina laevis*, though generally resembling those of *Palaemon malcolmsonii* and *Leander serratus*, are subject to a good deal of variations and modifications. The most important appendage connected with feeding is the second maxilliped. The maxillae and the first maxillipeds do not take any part in mastication. Though in decapods, generally, the articulation between the coxa and basis of the third maxilliped is almost always immovable, it is quite movable in *Caridina* and in fact the major movements of this appendage take place here. The system of spines borne by this appendage (11-13 rows situated on the concave mesial side of the propodus—dactylus) is used by the animal as a brush for cleaning the antennae and the brushes of the chela. The "exite" situated on the outer side of the proximal endite of the maxillule and having the same relations as the large external plate of the maxillule of Euphausiacea is exceptionally well developed in *Caridina*. This is interesting because it is not even represented in the other members of the tribe Caridea. The mandibles are highly asymmetrical. There is an additional transverse tendon at the base of the two longitudinal tendons connecting them together. A lacinia mobilis, is represented in *Caridina* by the appendages borne on the rim of the depression separating the molar process from the incisor process, as in Syncarida. This is a primitive character and is not seen in the Palaemonidae. However all the mouth parts, especially the mandibles tend to be reduced. This is correlated with the retention of a comparatively more advanced type of gastric mill.

The animal feeds on vegetable, animal and inorganic substances as revealed by the stomach contents. Two independent currents of water are produced, a strong respiratory current entering the branchial cavity through the cleft between the edges of the carapace and the bases of the thoracic appendages and escaping in front on either side, and a minor food current entering the "food basin" from below and emerging anteriorly through the space formed between the incisor process and the labrum. This minor current is assisted by the movements of the

exopods of the last two maxillipeds. The masticated food is taken into the stomach by the action of the constrictor muscles of the esophagus together with oral gulps of water taking place at regular intervals.

19. Geographical Distribution of the Prawns of the subfamily Pontoniinae (Crustacea : Decapoda : Palaemonidae).

KRISHNA KANT TIWARI, Calcutta.

Pontoniinae is one of the four subfamilies of Palaemonidae. It contains the largest number of palaemonid genera and is exclusively marine in habitat. Many representatives of this subfamily live in association with other marine invertebrates and have undergone interesting structural modifications depending upon the degree of relationship.

Holthuis has listed 32 genera containing 196 species and one variety in this subfamily. Fifteen of these genera are monotypic and only seven contain four or more than four species. Majority of these prawns are confined to the tropical and subtropical regions where they form an important constituent of the shelf fauna. With a few exceptions, all the known species are recorded from depths not exceeding 70 metres.

The geographical distribution of this subfamily shows some interesting features. Of the 32 genera, only eight have wider distribution in more than one marine Zoogeographical Zone (as defined by Ekman) while the remaining 24 are confined to one or the other. Thus 18 genera containing 39 species are exclusively Indo West Pacific in distribution, 4 genera having five species occur in the East Pacific, while the West Atlantic and East Atlantic have one monotypic genus each.

Of the eight widely distributed genera, two are circumtropical while the remaining six occur in more than one, but not all the four zones.

With a single exception of *Harpliopsis depressus* which occurs in the Indo West Pacific as well as East Pacific, none of the species found in one region occur in another. The geographic discontinuity at the species level is thus complete.

The Indo West Pacific is the richest not only in genera but also in species of Pontoniinae. About two-thirds of the genera and half the total number of species of Pontoniinae are known to occur in this region. The East Atlantic has only 5 genera containing 10 species.

The facts emerging from an analysis of the distributional data of this subfamily have been discussed in some detail.

20. Another new species of *Nichollsia* (Crustacea : Isopoda : Phreatoicoidea).

KRISHNA KANT TIWARI, Calcutta.

The suborder Phreatoicoidea of isopod crustaceans was so far represented in India by a single species, viz., *Nichollsia kashiense* Chopra and Tiwari, a subterranean crustacean occurring in wells at Banaras and Lahagara in U.P. The present paper adds another Indian species to this suborder, specimens of which were collected from a well in the Dak Bungalow at Monghyr in Bihar. The types of this new species are deposited in the Zoological Survey of India, Calcutta.

(v) Entomology

21. Anopheline Collections of Lucknow.

H. M. L. SRIVASTAVA, Lucknow.

Ten species of Anopheline mosquitoes were collected in Lucknow town from 1951 to 1954. These species include *culicifacies*, *stephensi*, *fluviatilis*, *minimus*,

annularis, *pallidus*, *barbirostris*, *subpictus*, *vagus* and *splendidus*. Of these the first four belong to the vector species of Malaria in U.P. The remaining six are non-vectors of Malaria in the State.

Among the vector species *A. culicifacies* has been collected in large numbers from July to December. The other species i.e. *stephensi* is collected in large numbers from January to June. The collections of *A. fluviatilis* and *A. minimus* have been sporadic and negligible.

Among non-vectors, *A. subpictus* is the species which is collected all the year round in large numbers. The species which have been rarely collected include *barbirostris* and *splendidus*.

22. Probable Transmission of Yaws by Flies.

H. M. L. SRIVASTAVA, Lucknow.

Siphunculina funicolla, a small eye-fly belonging to the family Chloropidae or Oscinidae was collected in large numbers from the open wounds of Yaws. When the wounds were cleared, 15 to 20 flies were attracted per minute. This strongly suggests that the fly may be acting as a mechanical carrier of Yaws Spirochaete. The external characters and the breeding habits of the fly have been described in detail.

The investigations were carried out in Dudhi Tehsil of Mirzapur district.

23. Mantodean Oothecae.

G. L. ARORA and INDERMOHAN SINGH, Hoshiarpur.

This paper deals with a detailed account of the form and structure of the oothecae of mantids collected from Hoshiarpur and the neighbouring places.

Among Dictyoptera, the eggs are deposited in large egg packets termed oothecae. A large number of oothecae have been obtained both from the fields and the experimental cages in the laboratory. The oothecae belong to *Aethalocroa ashmoliana* (Sub-family Toxoderinae), *Creobroter apicalis* (Sub-family Hymenopodinae), *Deiphobe incisa*, *Deiphobe* sp., *Mantis religiosa*, *Mantis* sp. and *Hierodula* sp. (Sub-family Mantini). A thorough examination of their external characters and internal structure has been made. It has been found that the basic structure conforms to a fundamental plan, consisting of an inner zone containing the egg-chambers, and a peripheral zone forming a protective covering, the two separated by a partition wall. Two sets of oothecae are recognisable. To the first set belong oothecae of *Aethalocroa* and *Creobroter*, characterized by the central zone extending almost through the entire breadth of the ootheca, a haphazard and irregular arrangement of the egg-chambers, absence of the middle line, and a thin protective peripheral layer. In the second set are included the rest of the oothecae in which the central zone is confined to the inner region with egg-chambers regularly arranged on either side of the middle line and in which the peripheral zone is of a considerable thickness. The oothecae of the Madagascan mantid and of *Gongylus gingyloides* have recently been described by CHOPARD (1952 in GRASSI: *Traite de Zoologie*), the former with a jumbled mass of egg-chambers in the centre and the latter having ill-defined rows of egg-chambers. We can from the above trace an evolutionary series of the oothecal forms, beginning at the simple ootheca of the Madagascan mantid with a jumbled mass of egg-chambers, through forms like *Aethalocroa*, *Gingylus*, and *Creobroter* with egg-chambers haphazardly or irregularly arranged, to the most highly evolved oothecae of *Deiphobe*, *Mantis* and *Hierodula* etc. with egg-chambers arranged in a definite manner on either side of the middle line.

24. On the Morphology of the Common Earwig, *Labidura* sp. (Dermaptera).

KUSUMAVATI KADAM, Delhi.

Earwigs are insects that have a fairly wide distribution all over the world. Several genera are recorded from India of which two, *Labidura* and *Forcipula*, are common in Delhi. Of the two *Labidura* is available in greater abundance than *Forcipula*.

Lhoste from France described the anatomy and physiology of the alimentary canal of *Forficula auricularia* in 1941. It is a very short and sketchy account which needs thorough revision. No attempt has so far been made on any aspect of the morphological studies of any Indian earwig.

While work on the general morphology of *Labidura* sp. is progressing, the alimentary canal and the associate structures which show some points of interest are being presented in this paper.

The alimentary canal of *Labidura* is of the usual type, a long slightly coiled tube from mouth to anus, and is divisible into the fore gut, the mid gut, and the hind gut. The fore gut and the hind gut are formed by the ectodermal invaginations, lined by a thin chitinous layer.

The fore gut is again distinguishable into the buccal cavity, the pharynx, the oesophagus, the crop, and the gizzard or the proventriculus. Proventriculus is a highly specialized part of the alimentary canal, details of which are given in the paper.

25. Studies on *Brachythemis contaminata* Fabricius (Odonata). Neck and Prothorax and their musculature.

A. C. MATHUR, Lucknow.

The neck is supported by three dorsal cervicals, two pairs of lateral cervicals, and three ventral cervicals. The prothorax consists of a median dorsal pronotum; a pair of lateral propleurons, each consisting of a proepisternum and proepimeron; and the ventral prosternum which is divisible into anterior probasisternite and posterior profurcasternite by a transverse sternacostal suture which has an apophyseal pit at each end. A pair of prothoracic, articulating sclerite is also present. The prothoracic leg is divisible into a coxa, two segmented trochanter, femur, tibia, three-segmented tarsus and the pretarsus which is represented by the unguifer process, the unguitractor and a pair of claws. In the neck and prothoracic regions there are ten intersegmental muscles, nine segmental muscles and eight intrinsic muscles of leg.

26. Ovulation and Corpus Luteum Formation in Insects.

T. SINGH, Dehradun.

1. The reproductive cycle of females of the insects *Locusta*, *Schistocerca*, *Dysdercus*, *Ephestia* and *Phytodecta* has been studied by dissection and histological means with special reference to ovulation and the formation of the corpus luteum.

2. From original observations and those recorded in the literature it has been possible to distinguish three types of ovulation which are here denoted as (i) Independent successive ovulation, (ii) discontinuous multiple ovulation, (iii) continuous ovulation.

3. Correlated with these types of ovulation, three types of corpora lutea may be distinguished. A detailed histological account of the processes of corpus luteum formation is given.

4. In insects with independent successive ovulation each corpus luteum arises by degeneration of a single follicle (eg. *Locusta*). In those with discontinuous multiple ovulation each corpus luteum is formed from several follicles (eg. *Dysdercus*), while in *Ephesia*, with continuous ovulation, a single corpus luteum is developed through telescopic condensation of a large number of follicles.

5. The true corpora lutea, developed from degenerating follicular epithelium after ovulation, are distinguished from the pigmented resorption bodies which are associated with degeneration of an oocyte which is not ovulated.

6. The above data, with some others from the literature, provides a classification of the basal ovariole bodies which helps to reduce the confusion previously existing.

27. Observations on the 'Corpus luteum' and the 'NR bodies' in the Female gonads of bed-bug.

B. DASGUPTA and H. N. RAY, Calcutta.

After ovulation, in bed bugs (*Cimex lectularius columbarius* Jen. and *Cimex lectularius lectularius* L.) the cells of the empty follicle lost their individuality resulting in the formation of a syncytium called the 'corpus luteum' and this process was preceded by a sharp rise of ribonucleic acid in the cells concerned. The syncytium was used up in the process of growth and expansion of the next on-coming follicle. The rise of ribonucleic acid content of the cells appeared to indicate some kind of active synthetic process. It also appeared possible that this was accountable with the amount of energy-spending mechanism of cells in expelling the ovum into the oviduct.

The pathological inclusions termed 'NR bodies' occurred in the nurse cells, in the follicle cells and also in the 'corpus luteum'.

The formation and the disappearance of the 'corpus luteum' is considered as a continuous process of reorganisation and reorientation and the degenerative changes, as sometimes noticed in the 'corpus luteum', is ascribed to the presence of 'NR bodies'.

28. Thoracic musculature in the alate and the de-alated phases of the Sexualls of the termite *Odontotermes redemanni* (Wasmann).

D. MUKERJI and BARUNDEB BANERJEE, Calcutta.

A comparative study on the thoracic musculature of the alate and de-alated sexualls has been undertaken. Variations in the musculature occur, due to the casting off, of the wings of the imago after it becomes sexually mature. Unlike the alates, the wing muscles of the sexualls no longer occupy greater part of the thoracic cavity, but are broken down and scattered throughout the thoracic cavity. Other thoracic muscles, such as, dorso ventral, tergal and sternal muscles of the sexualls also show signs of degeneration. In the de-alated male, the degeneration of the thoracic muscles is not so pronounced as in the female.

29. A note on the life-history of *Anthrenus vorax* (family Dermestidae, order Coleoptera).

BARUNDEB BANERJEE and D. MUKERJI, Calcutta.

The life-history of *Anthrenus vorax* has been studied in relation to food, light and temperature. The observations are:—

(1) Eggs kept in direct sunlight do not hatch, but those in cold dark places hatched out in 5-6 days.

- (2) By varying the amount of food, two series of moults were observed. (5 & 6).
- (3) Life-history could be prolonged by regulating the diet at different stages.
- (4) Larvae reared by controlling diet at different stages are of low vitality than those developed under normal conditions.

30. Musculature of the head of *Periplaneta americana*.

R. RAKSHPAL, Lucknow.

The head has 29 pairs of muscles. Five pairs belong to the antennae and they are the levator, depressor, rotator, flexor and extensor. The labrum has two pairs *viz.*, the anterior and posterior retractors. Each mandible possesses two muscles, the adductor and abductor. Each maxilla has eleven muscles, *viz.*, promotor and adductor of cardo; adductor of stipes; cranial and stipetal flexors of the lacinia; flexor of the galea; levator, depressor of the maxillary palp; levator, depressor and reductor of the second, fourth and terminal palpal segments respectively. The labium has nine pairs of muscles and they are the anterior and posterior retractors, and flexor of prementum; flexors of glossa and paraglossa; levator and depressor of the labial palp; levator and depressor of the second and terminal palpal segments respectively.

31. Bacterial control of *Heliothes obsoleta* (F).

S. K. MAJUMDER, M. MUTHU and S. V. PINGALE, Mysore.

An experiment carried out to control *H. obsoleta*, a major insect pest of a number of economic crops, by a bacterium observed to be pathogenic in nature, forms the subject of the paper. The virulence of the bacterium on subculturing in artificial medium, the concentrations necessary to induce disease on ingestion of the sprayed material and symptoms of the disease produced are reported. The results of the trials carried out on potted plants and in the field on *Dolichos lablab* are given which indicate that the disease caused by the bacterium is contagious, specific and could be successfully used in the control of the insect. It is considered that the chemical control methods, as advocated to-day, may be temporary in effect and causing residue hazards. The form of biological control discussed in the paper, if found satisfactory, could overcome these difficulties.

32. Observations on *Noorda albizonalis* Hamps. (Pyralidae).

G. C. SEN GUPTA and D. MISRA, Bhubaneswar.

Since 1953 mango fruits have been found to be damaged by the larva of the Pyralid, *Noorda albizonalis* Hamps., in some parts of Puri District in Orissa State. This is the first record of this Pyralid as an important pest of mango in India. Earlier in 1930, this Pyralid was reported as a major pest of mango in various parts of Java. Experimental work was undertaken to study this Pyralid and to evolve a suitable control measure. A short account of the life history, habits, distribution, control measures, nature and extent of damage to mango in Orissa has been given.

Noorda albizonalis Hamps. completes its life cycle in 26-36 days under laboratory conditions at Bhubaneswar. The eggs are laid in clusters on the peel of the fruits. The egg stage lasts for four days. The larval period varies from 10 to 16 days. The larva undergoes four moults before pupation. The pupal period

varies from 12 to 16 days. Mango fruits of different sizes are attacked by the caterpillars. Up to 5 caterpillars are found in one mango but a few are sufficient to cause the fruit to decay. The caterpillar usually bores the fruit at the posterior end, feeds first on flesh, later on the seed, which is destroyed. The infestation of fruits ranged from 12.2% to 80.5%.

Three sprayings of D.D.T. 50% wettable powder (in terms of 4 lbs. of active ingredient per 100 gallons of spray) were done on mango fruits before infestation at the interval of 15 days to study the effect. These fruits were free from the infestation throughout the season. The untreated fruits of trees even in adjacent rows were damaged by these borer caterpillars: As the caterpillars pupate in the soil, the soil round about the trees should be raked up to kill the pupae.

33. Bionomics of Waxmoth, *Galleria mellonella* Linn.

R. L. GUPTA, Nagpur.

Life-history, different stages, nature and extent of damage and control of *Galleria mellonella*, Linn were studied in 1946-47. The eggs are laid singly or usually in groups of 2 to 200 attached by a gummy material in the slits of hives or on combs. The female moth derived from fullfed larva lays from 500 to 900 eggs. Egg period varies from 5 to 15 days. The larva begins to feed with cell on the median septum forming small fine gallery of silk excreta and particles of comb. The larva undergoes five moults and six instars and the larval stage varies from 25 to 40 days. The larva pupates within a white silken tightly worn cocoon inside or in between the combs. The pupal period varies from 8 to 10 days. The sexual dimorphism of adult moths has been described. The pest is active throughout the year. It is a very bad pest of combs of honey-bees in Madhya Pradesh. The attacked combs are more or less completely destroyed especially in weak colonies with all the wax being eaten up by the larvae, containing a loose mass of silken larval galleries and cocoons.

34. A Note on Life-history of *Euzophera perticella* Rag.

R. L. GUPTA Nagpur.

It is an important pest of brinjal feeding on the pith, wood and the bark. In the early stage of the crop the attack is generally negligible. In the later stages, however, the incidence rises high and may shoot up to 100%. The damage is generally restricted to the main stem near the root. A single female laid from 104 to 363 eggs. The eggs are generally laid singly or in twos in the axils of leaf or branch or on knots. They are roughly spherical, pale yellowish brown in colour with hexagonal sculptures. The eggs hatch in 6-12 days in winter. The newly hatched larva is pale yellowish white in colour with a rosy tinge and sparsely scattered hairs on the body. It tapers posteriorly. The head is very prominent and pale yellowish-brown. The larva bores inside the stem through the bark and feeds on the pith and wood or even bark making galleries inside the stem and packing behind the gallery by its excreta and excrement of wood. The caterpillar takes about 7-11 weeks in winter for its full development and remains inside the stem throughout this period. The full grown larva is pale yellowish in colour, with a prominent yellowish brown head with distinct segments having sparsely arranged hairs. The caterpillar generally pupates in a silken cocoon inside the stem, near the exit hole previously made by the larva prior to pupation. The adults emerge in about 6-27 days and live for 6-15 days. The pest was present in the field throughout the year with 5 to 6 overlapping generations. Two larval

parasites, (1) *Pristomerus testaceus* Morley., (2) *Phanerotoma hendecosisella* were recorded. The percentage of parasitism ranged from 50-70 per cent.

35. Life-history of *Macalla* sp.

R. L. GUPTA and H. S. CHACHORIA, Nagpur.

The pest is serious in vicinity of Nagpur where it damages and webs the shoots to the extent of about 50%. The affected trees are conspicuous from a distance by the presence of webbed-dried shoots. A female was recorded to lay from 168 to 309 eggs in the laboratory. Mating takes place after 24 hours to 40 hours of emergence and is frequent. Centpercent eggs are viable. Incubation period was from 4-9 days. The newly hatched larva is light green in colour with faint pink lines running longitudinally. It feeds on chlorophyll of the leaves. A fully grown larva is 28 to 32 m.m. long and is deep brown or black in colour. The larva feeds and pupates inside the fold of leaves. The larval period is 35 to 70 days and 25 to 36 days during winter and summer, respectively. The pupal period ranges between 12 to 16 days in the summer and 20 to 37 days in the winter. *Brachymeria* sp. (Chalcididae) has been found as the larval parasite, while *Eurytoma* sp. (*Eurytomidae*) and *Hormius* sp. (Braconidae) have been found as pupal parasites. The damage is less pronounced in the beginning i.e. July and increases with the advancement of season reaching its maximum during October, November and December. The pest can be controlled by mechanically picking out the webbed shoots by the help of long bamboos or by dusting 5% DDT.

36. On some serious seasonal and forced predatory enemies of lac.

S. KRISHNASWAMI, N. S. CHAUHAN and P. S. NEGI, Namkum, Ranchi.

Apart from the usual loss amounting to over 40% of the cells on an average, in a lac crop due to the predatory and parasitic insect enemies, a new type of damage to female lac insects in the *Baisakhi* and to some extent *Jethwi* crops towards crop maturity has come to light since recent years. This is observed and is serious particularly in areas experiencing a very hot summer. The damage is characteristic in its nature and time of its occurrence. Artificial partial defoliation of *Butea monosperma* (palas) has been devised to enable larger number of lac females to escape summer heat and drought and live to maturity, but in hot places like Kundri in Bihar this good effect is vitiated to a large extent by certain enemies at the most inopportune time. Investigations conducted in 1954 and 1955 leading to examination of stomach contents of squirrels shot from the affected trees and the area and actual field observations on their behaviour, at the time of damage and artificial feeding of captives revealed that the common five striped squirrel (*Funnambulus pennanti* Wr.) feeds voraciously on female lac insects towards crop maturity. Stomach content examination and field observation of ten species of birds also indicated that some of them are also responsible for damage to a certain extent.

An assessment of damage caused by squirrels and birds together in 1955 season showed that, of the 71.9% of the twigs bearing living cells, upto 47.8% were damaged. Estimation on the basis of cells revealed that only 23.9% survived the effect of heat in the area and of this small percentage upto 58.4% were destroyed by these agencies, thus resulting in a serious loss at the critical time of the crop. Probable reasons for this damage seem to be scarcity of normal food and water both of which are provided by lac females to a large extent. Some possible control measures are also discussed.

37. Note on the Life-history of *Lema semiregularis* Jac. (Crioceridae) together with a list of recorded Food-plants of known Species of *Lema*.

G. C. SENGUPTA Bhubaneswar and B. K. BEHURA, Cuttack.

Lema semiregularis Jac., is recorded for the first time as a pest of turmeric (*Curcuma longa*). The life-history from egg to adult takes about 39 days. The different stages are described. The pest is so far confined to the district of Phulbani in Orissa. A list of recorded food-plants of different species of *Lema* is given.

38. Observations on the Biology of *Aphis craccivora* Koch. (Aphididae : Homoptera).

BASANTA KUMAR BEHURA, Cuttack.

Aphis craccivora Koch. (Syn : *A. laburni* Kalt., *A. medicaginis* Koch.) is most abundant during October to January and is a serious pest on *Dolichos lablab* L., *Vigna catjang* Endl., *Phaseolus mungo* L., and *P. aureus* Roxb. (Syn : *P. radiatus* L.). It also occurs on *Sesbania bispinosa* (Jacq.) (Syn : *S. aculeata* (Willd.)), *Heliotropium indicum* L., *Plumbago zeylanica* L., and *Amarantus gangeticus* var. *oleraceus* Roxb. In the Laboratory at a temperature of 73°F to 78°F, the largest number of young produced by a single apterous parthenogenetic female was 29, and the maximum number of broods produced within 24 hours was 12. The young undergo four moults. The interval between each instar was usually 24 hours or less, although in some cases it was delayed upto 72 hours. Within 24 hours of the attainment of the adult stage, the apterous female began producing the broods. The largest number of days a single, apterous female lived was 12 days. The aphid species is often attended by the common black ant *Camponotus* (*Tanaemyrmex*) *compressus* Latr.. *Chilomenes sexmaculata* Fabr., is the chief enemy of *A. craccivora*. A list of recorded host-plants of the aphid species in India is given.

39. Effect of Insect Infestation on Stored Bengal Gram and Green Gram.

G. V. PINGALE, S. B. KADKOL and M. SWAMINATHAN, Mysore.

Bengal gram (*Cicer arietinum*) and green gram (*Phaseolus radiatus*) were subjected to damage by *Bruchus chinensis* under controlled storage conditions and the changes brought about in weight, viability, nitrogen, carbohydrates, fatty acids and thiamine content were investigated. It has been shown that considerable loss to the weight and viability of the grain occurred as a result of insect infestation. In addition, the infested grain was observed to be poor in thiamin and rich in fatty acid contents. Some changes in Nitrogen occurred but they did not appear to be of great significance. In respect of *dahl* prepared from infested grain a pronounced effect on the yield and taste was noticed. As a result it is concluded that where taste, flavour and the hygienic condition are the criteria for judging the value of the grain, insect infestation could bring about losses much greater than so far realized.

40. Studies on *Pseudococcus filamentosus* Ckll. Var. *Corymbatus* with reference to its Damage to Jute crop.

N. DUTT and R. N. GANGULI, Barrackpore.

Pseudococcus filamentosus var. *corymbatus* is noted for the first time as causing serious damage to both *capsularis* and *olitorius* jute. Injury which the pest inflicts

on the host arrests the vertical growth of the stem and the attacked region differentiates out by its green colour, swelling, shortened internodes. The stem also shows growth of helicoid nature and in cases of severe attack a loop is formed by the stem. Leaf-petioles arising from the attacked region become stunted and the lamina at times becomes crumpled. Leaves arising from the closely apposed nodes give the attacked region a bushy appearance.

It has been ascertained that first instar nymphs can induce development of the damage symptoms while the later instars or the adults are not associated with such damage. First instar nymphs can only induce the damage if infestation be given at the tip of the plant. Apex of the plant thus represents the susceptible site for damage.

There is a general inhibition of internodal length in affected plants in comparison to normal. Again, in the affected portion of an attacked plant, the inhibition of internodal length is more than 3 cm. on average than the unaffected portion, but the stem diameter of the affected portion shows an increase of 0.16 cm. over the stem diameter just below the affected portion. Explanation of this increase in stem diameter can be found in a number of changes of tissue structure induced by the injury. There is increase in the number of cell layers and cell volume in cortical, xylem and pith tissues of the affected portion of a damage plant.

41. Preliminary observations on Response to light of a Coccid-inhabiting parasite.

S. MASHOOD ALAM, Aligarh.

Photokinetic and phototactic reactions of *Metaphycus taxi* sp.n., to light are recorded. In the former case experiments in low light intensity (0.0316 log. ft. lambert) and higher light intensity (1.59 log. ft. lambert) are carried out and results, so achieved, show increase in orthokinesis at higher light. Experiments on phototaxis are done both with one light source and two light sources. Those with one light source not only manifest the attraction of parasites towards the source but, also, reveal gradual increase in the speed of parasites as they come closer and closer to the source. The experiments with two light sources are indicative of positive photo-tropotactic behaviour of *Metaphycus taxi*.

42. Observations on the Copulation, Host Selection and Oviposition behaviour of a Coccid-inhabiting parasite.

S. MASHOOD ALAM, Aligarh.

Actively moving male *Metaphycus taxi* sp.n., when encounters a female, starts the activity of copulation. He takes up face-to-face position with the female and taps the inner surface of her antennae with his own. A similar response from the female is an indication of her unwillingness and the male makes way for her to move away. A willing female does not respond and the male, after moving along a seim-circular path on her side for some times, ultimately, mounts her to enforce copulation.

The experiments on host selection consist of combinations of unparasitized host-coccids (*Eulecanium taxi* Habib) and parasitized coccids with parasites at different stages of development. The results achieved can be summarized as follows: (i) the female parasite fails to differentiate between unparasitized and newly parasitized hosts (ii) she can correctly differentiate unparasitized hosts from hosts containing parasites at advanced stages of development, thereby, selecting the former for egg-laying, (iii) the host selection behaviour of the parasite is, probably, not related with any specific type of arrangements of the hosts.

The life-cycle of *Metaphycus taxi* has a pre-oviposition period of twenty-four hours in a Constant Temperature Room running at 27°C with 70% Relative Humidity. She parasitizes only the second stage nymphs of *Eulecanium taxi*, whose head region and the peripheral rim are never used by the parasite for oviposition—a fact suggesting presence of co-relationship between the depth of host's body and the behaviour of oviposition of the parasite. The parasite, gradually, drills into host's dorsum with the help of her styltes. She also widens the puncture by sideways bending of her styltes during the act of drilling. The actual egg deposition comes in sequence of the repeated contraction of parasite's venter against the dorsum and the basal part of her genitalia.

43. Observations on Gamma BHC-Resistant Houseflies.

NAWAB H. KHAN, Aligarh.

Most of the work on resistant flies has been done with DDT alone with little or no effort being made to find out the resistance of flies to other insecticides. In the present paper, therefore, an attempt has been made to study the resistance of *Musca domestica* to gamma BHC.

Measured drops of gamma BHC solutions were applied on the dorsum of the thorax of individual flies by means of a microsyringe, the flies being previously given a slight dose of CO₂ to make them unconscious for a few seconds. Mortality counts were made after 24 hours of applications and 4 days old flies were used in all the tests.

The results obtained confirmed the earlier belief that insecticidal resistance decreases if the flies are continuously bred without exposure to the insecticides and that the resistance can be increased by continuously breeding the survivals of the treated flies in various generations.

44. Insecticidal Properties of Pongamia glabra (Karanja) Seed oil.

MRS. Z. H. OSMANI and M. B. NAIDU, Hyderabad, Deccan.

Karanja oil and its alcohol soluble portion (crude karanjin) in different concentrations in acetone were applied topically with a microsyringe to house flies. It was observed that 8 per cent karanja oil produced 98 per cent mortality in 24 hours, while 4 per cent crude karanjin caused hundred per cent mortality in eight hours. On spraying directly on house flies, 10 per cent karanja oil at the rate of 0.0026 grams per sq. cm. and 4 per cent crude karanjin at the rate of 0.0016 grams per sq. cm. produced hundred per cent mortality in 24 hours. Oil from which alcohol soluble portion has been separated had very little insecticidal value.

Low mortality rate was observed in 48 hours when *B. chinensis* and *T. castanum* were confined to surface treated with 4 per cent crude karanjin. From these results it appears that the potency of the toxic principle of karanja oil is of restricted nature.

45. Waves of Locust swarms and the damage caused by them.

A. S. SRIVASTAVA, Kanpur.

The year 1954 faced the worst locust invasion of *Schistocerca gregaria* Forsk during the last decades. Six waves of successive locust swarms invaded practically more than 49 districts of Uttar Pradesh. These swarms laid eggs in 16 districts, viz., Dehra Dun, Saharanpur, Muzaffarnagar, Meerut, Bulandshahr,

Aligarh, Agra, Mathura, Moradabad, Bijnor, Etah, Rampur, Nainital, Badaun, Pilibhit and Jhansi over an area of 1,74,168.8 acres during the months of June, July, August, September and October. The control operations were organised on an unprecedented scale over all the districts of Uttar Pradesh but were concentrated particularly in the egg-laying districts. As a result of these extensive control operations 1042 mds. of adult locusts were killed. Eggs and hoppers were destroyed in an area of 1,36,265.4 acres. The damage caused to various crops in Uttar Pradesh by adult locusts and hoppers was negligible and amounted to only Rs. 36,613/8/-. 5% and 7% BHC dusts were particularly used for the control of adults and hoppers. As a result of these wide scale operations not a single locust swarm could be formed in any part of Uttar Pradesh during the year 1954.

46. Locust Invasion in Uttar Pradesh. Period of Egg-hatching in different months.

A. S. SRIVASTAVA, Kanpur.

During the year 1954, an unprecedented locust invasion of *Schistocerca gregaria* Forsk in Uttar Pradesh afforded a valuable ground for observing the hatching of eggs during the different months. It is already known that temperature and humidity influence the period of hatching of locust considerably. During the month of July the period of hatching in the various districts was—in Aligarh and Agra 13-16 days; Nainital 15-16 days; Rampur 14-15 days; Jhansi 14 days; Badaun 14-17 days; Pilibhit 16-20 days; Bijnor 18 days; Meerut 11-12 days; Muzaffarnagar 11-13 days; Bulandshahr 11-12 days; Moradabad 13-15 days; during the month of August—in Agra 14-19 days; Mathura 13 days; Meerut 11 days, in the month of September—in Agra 16 days; while in the month of October it was 21-28 days in Aligarh, 13-23 days in Meerut and 17-36 days in Bulandshahr.

47. An Insecticide from the Extract of *Adhatoda vasica*, Ness.

A. S. SRIVASTAVA and G. P. AWASTHI, Kanpur.

Watt (1908) has already given indications that the plant of *Adhatoda vasica* possesses some sort of insecticidal property, but this toxicity has not been assessed against the pests with modern bioassay techniques. It was, therefore, considered desirable to confirm this finding. The composite alcoholic extract from the leaves of *Adhatoda vasica* has yielded a resinous product, which was examined and found to be sufficiently toxic against the grain insect. This plant is commonly found in abundance throughout the plains of India and upto a height of 4000 feet and over hilly tracts. The extract from the leaves of this plant contains enough toxic ingredients to kill the grain insect, *Tribolium castaneum*, at the level of 1% concentration in alcohol. The yield of this composite extract from the leaves has been found to be 6.9% of the weight of dried powdered leaves. The toxic ingredients responsible for the mortality of insects have not been fully worked out and are under investigation. This extract is extremely harmless to man and thus possesses no health hazard even if consumed by persons along with the grains.

48. Synergism of mixture of sesamin and sesaminol with Nicotine Sulphate.

A. S. SRIVASTAVA and G. P. AWASTHI, Kanpur.

While making a survey of insecticidal properties of various plant products available in this country, it was found that a combination of Til oil (containing sesamin and sesaminol) with Nicotine sulphate has got sufficient toxic effects

again the mango and guava mealy bugs, *Drosicha stebbingi* and *D. contrahens*; while 0.2% Nicotine sulphur of 4% Til oil in water is completely ineffective against them, which are also not killed ordinarily by other common synthetic insecticides. The following formulation is a typical one employed against the mealy bugs and consists of Til oil 1.2%, Nicotine Sulphate 0.125% and soft soap 0.25% in water. This formulation gives a high control of the mealy bugs within 4 days. This phenomenon of synergism between Til oil and Nicotine Sulphate is observed for the first time, though it has been reported already for pyrethrin, Sesamin and Sesaminol.

49. A comparison of Malathion, Malathion with Chlordane, Parathion and Endrin sprays for Mangohopper control.

A. S. SRIVASTAVA and RAM PAL SINGH, Kanpur.

Mangohopper (*Idiocerus atkinsoni* and *I. clypealis*) is a serious pest of mango trees and treatment with 0.25% DDT emulsion has proved very effective against this pest in Uttar Pradesh. In order to find out a cheaper insecticide for its effective control, a number of modern synthetic insecticides have been sprayed on the mango trees infested with hoppers at the rate of 3 gallons of fluid per tree and it has been found that 0.05% Malathion has given 93%; 0.1% (50% malathion plus 50% chlordane), 97%; 0.02% folidol (Parathion), 88% and 0.025% Endrin, 89.8% control after 48 hours. The economics of all these insecticides has been worked out and found that all these insecticidal formulations are cheaper than DDT.

50. Water Relations of Leafhoppers (Homoptera : Jassidae).

K. N. SAXENA, Delhi.

Water relations of four species of leafhoppers (Jassidae) have been studied to explain certain structural and physiological peculiarities in these insects. The species studied are: *Hecalus lefroyi*, *Parabolocratus porrectus*, *Eutettix phycitis* and *Empoasca devastans*. Of these, first three possess a filter-chamber which is absent in the fourth.

The water content of all these bugs ranges from 63.64% (*Empoasca*) to 68.8% (*Eutettix*) of the total body weight. During fast, these insects lose water at a rapid rate and succumb to desiccation when the weight falls below 17.6% (*Empoasca*) to 26.6% (*Eutettix*) of the original weight. The rate of desiccation is governed by the saturation deficiency of the surrounding air. At any given saturation deficiency and temperature the jassids without filter chamber die much earlier than the jassids which possess a filter chamber.

The significance of these observations is discussed in the paper.

51. Physiological Significance of the Differentiation of the Mid-gut of Heteroptera.

K. N. SAXENA, Delhi.

Investigations have been taken up to elucidate the physiological significance of the differentiation of the mid gut of plant feeding Heteropterous insects into three or four regions, and also of the shortening of the hind gut. In *Dysdercus koenigii* Fabr. the hydrogen ion concentration of the gut contents varies in different regions. The first two regions of the mid gut are weakly acidic

(pH)6.0(6.8), the second two regions are more strongly acidic (pH)4.6(5.2), and the hind gut is weekly alkaline (pH)6.8(7.6).

The first ventriculus secretes at periodic intervals the enzymes *amylase* and *sucrase*. These enzymes pass backwards along with the food. *Maltase* has been detected in the second and third regions of the mid gut.

The transformation undergone by starch, sucrose and maltose within the gut of insects fed on solutions of these substances has been studied. The digestion of all these occurs only when they reach the third ventriculus though their enzymes occur in the preceding regions. It seems that the hydrogen ion concentration of the third ventriculus is more favourable to the activities of the enzymes than that in the previous regions.

Further studies on the digestion and absorption of proteins are in progress.

52. Growth response of *Trogoderma granaria* Everts. (Coleoptera; Dermestidae) to artificial diets.

N. C. PANT, Delhi.

Trogoderma granaria Everts. is a small dermestid beetle which is a serious pest of stored grains in its larval stages. The present paper deals with some of the aspects of nutrition of this insect. The larvae of this beetle have been successfully grown in artificial diets consisting of casein, glucose, cholesterol a salt mixture, a source of vitamins of B complex in the form of either dried yeast or in pure substances and 10% water. Casein, vitamin B, carbohydrate and minerals are absolutely essential for the normal development of larvae. Cholesterol, though essential, is not needed so vitally. Of all the factors of B-complex, nicotinic acid, and pantothenic acid are most essential. Without any of these factors the diets become entirely unsuitable. Choline chloride deficiency causes heavy but not complete mortality. Action of riboflavin is a little doubtful but its absence sometimes delays the rate of growth. Thiamin is needed for normal development. In the diets without pyridoxin, folic acid, p'-amino-benzoic acid or biotin (or water insoluble factor of yeast) larvae are able to complete their development normally.

53. Spontaneous Feeding Response to colours in *Papilio demoleus* L.

DORA ILSE and V. G. VAIDYA, Poona.

Freshly emerged imagines of *Papilio demoleus*, kept in a large cage devoid of any coloured object apart from those specially provided for the experiments, were offered artificial coloured flowers prepared from the standardized Ostwald series. On the coloured flowers, the inexperienced unfed butterflies showed a characteristic feeding response: they approached the artificial flower in flight, landed on it and unrolled their tongues with which they performed probing and sucking movements on the paper. The results clearly show that *Papilio demoleus*, in the feeding state, is mainly attracted to the blue and purple colours while the yellow, yellowish green, green and blue-green colours are completely neglected. Thus they have provided another proof that certain insects, contrary to Forel's assumption (1910), show not only acquired but also inborn preferences for colours. This result is also of interest from the point of view of comparative physiology. It is known that primitive insects often prefer yellow colours, while the more evolved ones prefer blue, violet and purple in the state of feeding. Comparatively primitive butterflies like some Nymphalids, flower-visiting Diptera, Aphides and Aleurodes prefer yellow to all other colours, while only the Pierids and Papilionids prefer the blue, violet and purple colours.

54. *Dermestes maculatus* Degeer as a pest of shoe industry.

P. SEN, Calcutta.

The insect *Dermestes maculatus* has been known as a pest of leather, skin etc. The present paper records an instance of heavy damage to the wooden cases meant for despatching shoes. The nature and extent of the damage, as also methods of control have been discussed.

55. Effect of Post-treatment Temperature on Insect Resistance to Insecticidal sprays.

S. PRADHAN and P. V. RANGARAO, New Delhi.

In an earlier publication by one of us an effort was made to show that in the study of the effect of temperature on insects' mortality due to insecticides the factor of temperature should be differentiated into three components viz., (a) *pre-treatment temperature*, (b) *treatment temperature*, and (c) *post-treatment temperature*. It was further brought out (i) that the treatment temperature component affects such functions as lead to a positive temperature coefficient of insecticidal action, (ii) that the post-treatment temperature component affects the inherent resistance of the insect and (iii) that the pre-treatment temperature component is likely to affect both the sets of functions mentioned above. The differentiation of the effects of temperature components (b) and (c) depends in practice on the technique of experimentation which has to be specially designed so as to eliminate the effect of one or the other component and thus to bring forth the effect of only one component.

Now it is possible to record here for the first time so far as known to us, quantitative experimental data showing that the graphical relation between post-treatment temperature and what may be called insects' resistance to insecticides is practically the same as that between temperature and other vital activities. In the case of DDT emulsions and suspensions and gamma BHC emulsions it has been found that there is an essential similarity between the curves connecting the value of LC_{50} and the temperature under which they were obtained and the usual curves connecting temperature with other biological activities. In other words the resistance increases with the rise of temperature upto a certain degree and then decreases with any further rise of temperature.

It may, however, be pointed out that such curves were not obtained with emulsions of chlordane, toxaphene and parathion. The values of LC_{50} in all these three cases decreased with the increase in temperature right from about 14°C to 40°C. The tentative inference at present is that in these cases it has not been possible with the technique used so far to eliminate the effect of treatment temperature component which has kept the effect of post-treatment temperature masked.

56. Comparative Efficacy of Different insecticidal dusts for the control of Locust (*Schistocerca gregaria* Forsk).

S. PRADHAN and B. KUMAR, New Delhi.

In these investigations, an effort has been made to determine the relative toxicity of some important synthetic organic insecticides to the first stage hoppers (lindane, aldrin, dieldrin, isodrin, endrin, chlordane, parathion), second stage hoppers (lindane, aldrin, isodrin, endrin, chlordane, parathion), third stage hoppers (lindane, aldrin), adult males (lindane, dieldrin), and adult females (lindane, aldrin,

dieldrin, parathion). In addition it has been possible to throw some light on some fundamental aspects of locust toxicology. The results are summarised below :

(i) Parathion has proved to be far more toxic than other insecticides tested. Dieldrin proved to be second, but far more toxic than the rest. The relative position of aldrin and lindane vis-a-vis each other is uncertain, sometimes one proves better and sometimes the other. Chlordane, isodrin and endrin have proved to be much less toxic than others, chlordane being least toxic and the relative positions of isodrin and endrin getting sometimes interchanged.

(ii) No significant difference has been found between the toxicity of lindane and *gamma* BHC (formulation from technical BHC containing all the isomers but concentration made according to *gamma* isomer content).

(iii) The difference in toxicity of different insecticides has gone on getting magnified from lower stages of hoppers to the higher stages of hoppers, those more toxic (parathion, dieldrin and aldrin) getting more and more toxic and those less toxic (chlordane, isodrin and endrin) getting less and less toxic than lindane.

(iv) The higher stages of hoppers are more resistant than the lower stages of hoppers to all the insecticides tested, but the increase in resistance from first stage onwards is not constant when different insecticides are used, the difference in relative resistance of different instars being wider in the case of less toxic insecticides.

(v) Adult females are more resistant than the adult males.

(vi) Arachnida

57. Investigations on the heart and haemolymph of the scorpion, *Palamnaeus bengalensis*, C. Koch.

M. S. KANUNGO, Cuttack.

Effects of acetylcholine and histamine on the isolated heart preparations of the scorpion were reported in the last session of this Congress. Few more drugs have been tested. Adrenaline accelerated and atropine inhibited the heart-beat. Both physostigmine and ether were without effect. Electrical stimulation showed tetanizability of the heart to some extent. All these experiments confirm the view of the author that the heart is of an innervated myogenic nature. Rate of heart-beat changed when both the pH and temperature were altered. A total haemocyte count of the haemolymph showed 2,100 corpuscles per c.m.m. The haemolymph showed no clotting. Addition of potassium oxalate to the haemolymph resulted in the precipitation of calcium oxalate, but without clot formation. Most of these results show considerable disparity from those of *Limulus*.

(vii) Mollusca

58. Intracellular Digestion in Lamellibranchs.

D. N. KAMAT, N. Wadia College, Poona-1.

There has been considerable difference of opinion whether protein digestion carried out by the digestive diverticula of the lamellibranchs is of the extracellular or intracellular type. The reason for this difference of opinion seems to be that the evidence was the result of morphological, histological and biological studies of the digestive diverticula of these animals.

In this paper biochemical evidence is presented which is based on the fact that the characteristics of the intracellular proteinases are distinct from those of the extracellular proteinases, viz. the former have their own distinct pH zone of activity and also their own distinct activators and inhibitors.

When such work was carried out, it was found that the proteinase from the digestive diverticula of the fresh water mussel, *Lamellidens corrianus* (Lea), has an optimum pH of 6.1, that it is activated by H_2S , Sodium cyanide, Cystine and Ascorbic acid, and that it is inhibited by Iodoacetic acid, Supric chloride and Manganese sulphate. In other words, this enzyme seems to have the characteristics of an intracellular proteinase like Cathepsin.

Thus the evidence presented here tends to indicate that intracellular digestion of proteins is being carried out in the cells of the digestive diverticula of the lamellibranches, as illustrated by the mussel, *Lamellidens corrianus* (Lea).

59. Relative strength of Digestive gland amylase in some common south Indian Gastropods.

V. R. MEENAKSHI, Annamalainagar.

The relative strength of the digestive gland amylase of *Pila*, *Melania*, *Ariophanta*, *Achatina*, *Viviparus*, *Telescopium* and *Onchidium* are studied. It is observed that the relative strength of the enzyme is directly related to the food and feeding habits of the animal. *Pila*, which is a pure herbivore has the most powerful amylase. The digestive gland amylase of *Melania* is weaker than that of *Pila* though this animal also is a pure herbivore. This is due to the fact that the animal is microphagus and has only small amounts of food to digest at a time. Besides there is a crystalline style which yields amylase. *Ariophanta*, *Achatina*, *Viviparus*, *Telescopium* and *Onchidium* are omnivorous and their amylase activity is much less than that of *Pila*.

60. The first pearl fishery in Independent India.

P. I. CHACKO, Madras.

The pearl fishery off Tuticorin, Gulf of Manaar, lasted from 19-3-1955 to 14-5-1955. Species fished were mostly *Pinctada vulgaris* and small proportions of *P. chemnitzii*, *P. anomoides* and *P. margaritifera*. Majority were 3-4 years old. Banks fished were Thollayiram, Vandaombathu, Saithombathu and Koothadiar pars. Thirty-five lakhs of oysters were lifted and a revenue of 1½ lakhs rupees realised. General attitude of the labour-force to work less and obtain more wages; injuries caused by razor-clams (*Pinna*), scorpion-fish (*Pterosis russelli*) and parrot-fish (*Halichoeres centiquadra*); presence of large sharks; and unfavourable conditions (rain, strong winds, swells, currents and turbidity) limited the fishing efforts. Occurrence of a sand-drift; invasion of oyster-enemies like ray-fish (*Rhinoptera javanica*) and spiny star-fish (*Pentaceros linckii*); rank-growth of weeds (*Caulerpa*, *Codium*, *Halimeda*, *Halygenia*, *Hypnea*, *Padina*, *Sargassum* and *Turbinaria*) and sponges (*Spongionella nigra*, *Siphonochalina communis*, *Cliona margaritifera*, *Suberites inconstans*, *Clathria indica* and *Petrosia testudinaria*) destroyed large numbers of oysters. Sex-ratio of the population averaged 2 males to 1 female. A sanctuary, quarter-mile in area, was created to maintain a breeding reserve. 12000 spats were salvaged from divers' catches and liberated back. Empty oyster-shells were spread over the banks to serve as clutch to the growing oysters.

(viii) Chaetognatha.

61. Studies on the Chaetognatha of the Visakhapatnam Coast.

The Chaetognatha of the Lawson's Bay, Waltair, together with notes on their seasonal distribution during the year 1952-1953 and indicator species of this coast.

T. S. SATYANARAYANA RAO, Waltair.

Of the 18 species of Chaetognatha collected from the Indian Ocean by the 'Sea-lark' expedition (Burfield and Harvey, 1926), 12 are to be found in this region.

They are *Sagitta enflata*, *S. bedoti*, *S. neglecta*, *S. regularis*, *S. hispida*, *S. pulchra*, *S. robusta*, *S. bipunctata*, *S. serratodentata*, *S. tenuis*, *Pterosagitta draco* and *Krohnitta pacifica*. The sporadic occurrence of *Sagitta bombayensis* is noted. *S. enflata* and *S. bedoti* occur in large numbers in these waters during the months of January and February and July-August period. *S. enflata* and *S. neglecta* are found to be the common forms in the neritic waters off this coast.

The possibility that *S. bedoti* is an indicator of the shore waters and *S. neglecta* an indicator of the shelf waters is suggested. Generally speaking it is during the period of the northerly current that most of the species recorded from this area are found along this coast. Comparative study of the distribution of *Sagitta enflata* along the east and west coast of India appears to indicate a succession of peak numbers of this species in relation to time at the different areas of the coast. On the east coast this peak appears to move from north to south, while on the west coast the movement is from south to north.

(ix) Fishes and Fisheries.

62. Some Observations on the Trout Farm and Hatchery at Achhabal, Kashmir.

SUNDER LAL HORA, Calcutta.

Trout farming is a well-established Government enterprise in Kashmir. Three hatcheries and farms for this purpose are run at Achhabal, Harwan and Laribal. Of these, the one at Achhabal is the most extensive and provides a great attraction to the tourist visiting the Valley.

During his stay at Achhabal in June 1954 and July 1955, the author made extensive observations on the working of the Achhabal Trout Farm. The stock position for the six years 1949-50 to 1954-55 is reviewed from all aspects and an account of the diseases and other causes of mortality are discussed. The nature of food provided to the trout stock in the Farm and the rate of growth of the Brown and Rainbow Trouts are given. The suitability of the food in relation to growth and mortality is discussed.

In conclusion, for the better management of the Farm and increased production of fish at low cost, it is suggested that sanitation of the Farm should receive early attention. The rational feeding of the fish, both qualitatively and quantitatively, is considered of the utmost importance. In view of the natural reproduction of trout in the streams of the Valley, the practice of stocking them with eyed ova needs consideration.

63. Anaemia causing mortality among Brown Trout at the Achhabal farm, Kashmir.

SUNDER LAL HORA, Calcutta.

While camping at the Achhabal Trout Farm in July 1955, the cause of mortality was investigated in the case of two Brown Trout that died on the 27th and 28th

of July. *Post mortem* examination in both cases showed lack of blood in all the organs causing acute anaemia. The causes of anaemia under hatchery conditions are discussed and mortality in the present case has been attributed to insufficiency of food, defective quality of food and bad method of feeding. Fishes suffering from general debility are given no special treatment and have, therefore, little chance of survival in a pond crowded with healthy fish of about the same size.

64. The Anatomy of the Clasper or Gonopodium of *Scoliodon sorrakowah* Cuvier.

TRILOK MAJUPURIA, Aligarh.

The gonopodia of *Scoliodon sorrakowah*, a common Indian shark show important peculiarities useful in taxonomy. The gonopodia of this species are far more advanced in structure. They are scroll like with a closed groove, characteristic of Scyllidae. The primitive type of gonopodium is of simple type without any longitudinal curves having a wide, open groove. The supporting fin rays together with basipterygium form the skeleton of the claspers. Anteriorly they are provided with a sufficiently long siphon. Radials of the pelvic fin are found to be overlapping the cartilaginous skeleton of the clasper. Bulbous callosities and flattened papillae at the distal end are completely lacking. The elongated sac is extended up to the pectoral region. Its wall is secretory, muscular and highly vascular.

Detailed description of the anatomical features of the gonopodium and siphon is given in the paper.

65. Inter-relationships between standard-length, body-weight, gonad-length and gonad-weight of *Polydactylus indicus*.

P. S. KAREKAR, and D. V. BAL, Bombay.

The material for this study on inter-relationships between the standard length, body-weight, gonad-length, and gonad-weight of *Polydactylus indicus* is collected from the Sassoon and the Princes' Docks, Bombay, where inshore and offshore fish catches are landed respectively. The data regarding the standard-length, body-weight, gonad-length and gonad-weight, on the application of test of homogeneity of means for different months, shows significant results. The significant variations in the first two factors in both the types of catches are mainly due to purposive selection in the offshore fishing and random fishing in the inshore waters. The variations in the gonad-length and gonad-weight are due to individual differences in the condition of the specimens.

The mathematical relation between the body-weight and the standard-length calculated from the data is $W = (0.6873) (L^{2.6347})$, where the weight is in grams and the length is in centimeters. The correlation coefficient between these two factors is as high as 0.9525 and hence significant. This study also points out that it would be uneconomical to catch fish smaller than 50.0 cms. from the commercial point of view.

The correlation study between the four factors shows that the total, partial and multiple correlation coefficients vary and on the application of t^2 test of significance, the population appears to be not homogeneous. However, on excluding the extreme values of the correlation coefficients the population turns out to be homogeneous.

66. Study on maturity and standards of *Polydactylus indicus*.

P. S. KAREKAR and D. V. BAL, Bombay.

The study of maturity of *P. indicus* is based on ovaries from 300 specimens collected at Princes' Docks, Bombay, during the period October 1952 to September

1953. It deals with observations on the structure of the ovary in different stages of maturation, with special reference to measurements of ova diameters and the total number of ova produced by an individual.

The immature ovary attains maximum weight of nearly 15.0 gms. in an immature fish, measuring 80.0 cms. The maturing ovary noted in fishes measuring 72.0 to 105.0 cms. in standard length, grows to a large size, varying within a wide range of 15.0 to 300.0 gms. in weight. The maturing ova measure from 0.21 to 0.70 mm. in diameter. The specimens ranging from 72.0 to 105.0 cms. in standard length, the ovary appears like a yellow papery bag weighing 300-450.0 gms. The transparent mature ova vary in diameter from 0.70 to 0.87 mm. and are accompanied by both the immature and maturing ova. After the extrusion of mature ova, the spent ovary appears like a bloodshot, wrinkled, collapsed sac containing mature ova along with the well advanced maturing ova or a few mature ova with the immature ones.

The study of ova diameter frequency polygons of ovaries in different stages of maturity lead to the classification of the ovaries in seven stages corresponding to the International Council Scale of maturity.

On critical examination of the incidence of ovaries in various maturity stages in different months, it was found that the different batches of the ova in advanced maturity stages, are not sharply differentiated from one another, thereby indicating that the passing of one batch of eggs into the next stage is a continuous process and hence spawning is extended over a long period. The state of mature ovary and the data on the frequency percentages of stages of maturity in different months also corroborate this inference.

In addition, the multiplicity of modes in the frequency polygons also suggest that during the spawning season, three batches of ova mature in succession and are extruded one after the other at certain interval of time over a prolonged period.

The data regarding ova count of about 40 maturing and 10 mature specimens shows that the number of eggs spawned in one batch may vary from 2550 to 4000 per gram sample of the ovary.

From the data in hand, it may be inferred that the minimum size at maturity may roughly be fixed at 80.0 cms.

67. Quantitative studies on the food of some herbivorous fishes of Uttar Pradesh.

S. K. MOITRA, Lucknow.

In order to determine their food habits, the stomach contents of twenty-six species of food-fish were qualitatively and quantitatively investigated for a period of two consecutive years (1953-1955). The nature of the gut contents reveals that the following seven species of food-fish are all herbivorous since the food examined consisted mainly of plant organisms. The species are: *Labeo rohita* (Ham.), *Labeo gonium* (Ham.), *Labeo calbasu* (Ham.), *Labeo bata* (Ham.), *Cirrhina mrigala* (Ham.), *Cirrhina reba* (Ham.), and *Amblypharyngodon mola* (Ham.). The plant organisms identified in the food are desmids (*Closterium* sp., *Cosmarium* sp.), diatoms (*Cyclotella* sp., *Nitzschia* sp., *Synedra* sp.), algae (*Volvox* sp., *Gonium* sp., *Phacus* sp., *Eudorina* sp., *Pandorina* sp., *Anabaena* sp., *Nostoc* sp., *Oscillatoria* sp., *Rivularia* sp., *Microcystis* sp., *Spirogyra* sp., *Ulothrix* sp., and *Cladophora* sp.), and higher aquatic plants (*Hydrilla* sp., *Salvinia* sp., *Vallisneria* sp.).

Quantitative estimation of the gut contents indicate that the volume of food consumed by the fishes in the different months of the year varies and is the highest by volume and dry weight from July to October.

68. Quantitative studies on the food of some omnivorous fishes of Uttar Pradesh.

S. K. MOITRA, Lucknow.

Qualitative and quantitative investigations were made on the gut contents of twenty-six species of food-fish obtained from local fresh water bodies during the period July 1953 to July 1955. From the analysis of the gut contents it is concluded that the following six species of food-fish are omnivorous feeders since they show equal preference for both the plant and animal organisms, depending on the availability of the food organisms in the environment. The species are: *Catla catla* (Ham.), *Puntius sarana* (Ham.), *Puntius sophore* (C. & V.), *Rohitee cotio* (Ham.), *Gadusia chapra* (Ham.), and *Ailia coila* (Ham.). The food organisms recovered from the gut contents are desmids, diatoms, algae, higher aquatic plants, crustaceans and their larvae, insects and their larvae, and molluscs.

Quantitative estimations show no marked variation in the volume of the food consumed by the fishes throughout the year. The feeding habits of these fishes indicate a shift to plant food when animal food reaches the low level of its annual cycle and vice versa.

69. Quantitative studies on the food of some carnivorous fishes of Uttar Pradesh.

S. K. MOITRA, Lucknow.

The stomach contents of twenty-six species of food-fishes obtained locally during the period 1953-1955 were qualitatively and quantitatively examined in order to ascertain their food habits. The following thirteen species of food-fishes were found to be carnivorous since they feed mainly on rotifers, crustaceans, insects and their larvae, fish and fish-scales. The species are: *Callichrous pabda* Ham., *Mystus seenghala* (Sykes), *Mystus vittatus* (Bloch), *Mystus cavasius* (Ham.), *Notopterus chitala* (Ham.), *Oxygaster bacaila* (Ham.), *Mastacembelus armatus* (Lacep.), *Xenentodon cancella* (Ham.), *Wallago attu* (Bl. & Schn.), *Glossogobius giuris* (Ham.), *Ophicephalus striatus* (Bloch), *Ambassis nama* (Ham.), and *Ambassis ranga* (Ham.).

Quantitative estimations of the gut contents indicate that the volume of food consumed by these fishes varies during the different months of the year and is the maximum by volume and dry weight from September to December.

70. The surface-, mid-, and bottom-feeding fishes of Uttar Pradesh.

S. M. DAS and S. K. MOITRA, Lucknow.

By a careful examination for over two years of the stomach contents of adult fishes of U.P. it was possible to decide which of the fishes were surface-feeders, which mid-feeders and which bottom feeders. This was confirmed by plankton and bottom fauna studies under the guidance of the senior author.

The food of the surface feeders consists mainly of plankton algae, rotifers, plankton crustaceans and their larvae, insects and their larvae. The fishes belonging to this group and containing both omnivorous and carnivorous forms are: *Gadusia chapra* (Ham.), *Ailia coila* (Ham.), *Catla catla* (Ham.), *Ambassis nama* (Ham.), *Ambassis ranga* (Ham.), *Glossogobius giuris* (Ham.), *Callichrous pabda* (Ham.), and *Oxygaster bacaila* (Ham.).

The food of the mid-feeders consists of algae, aquatic plants, adult crustaceans, insects, fish and fish scales and mud and sand. The fishes belonging to this group,

both herbivorous and carnivorous forms, are *Labeo rohita* (Ham.), *Labeo bata* (Ham.), *Amblypharyngodon mola* (Ham.), *Mystus seenghala* (Sykes), *Mystus vittatus* (Bloch), *Mystus cavasius* (Ham.), *Mastacembelus armatus* (Lacep.), *Wallago attu* (Bl. & Schn.), and *Xenentodon cancilla* (Ham.).

The food of the bottom feeders consists of decomposed aquatic plants, bryozoans, molluscs, fish, fish scales, sand and mud. Sometimes crustaceans and insects are also present. The fishes belonging to this group and containing herbivorous, omnivorous and carnivorous forms are : *Cirrhinna mrigala* (Ham.), *Cirrhinna reba* (Ham.), *Labeo calbasu* (Ham.), *Puntius sarana* (Ham.), *Puntius sophore* (C. & V.), *Rohitee cotio* (Ham.), *Clarias batrachus* (Linn.), *Heteropneustes fossilis* (Bloch), *Ophicephalus striatus* (Bloch).

71. The scope of fisheries in the Bay of Bengal.

P. N. GANAPATI and T. S. SATYANARAYAN RAO, Waltair.

It is a well known fact that the fisheries on the east coast of India are meagre when compared to the west coast. An analysis of the material collected during the 32 oceanographical cruises conducted by the Andhra University during the years 1952-1955, has brought to light certain important hydrographical and biological features of the Bay of Bengal. They are discussed in the paper.

It may be stated that the great fluctuations in the salinity and temperature structure which take place in the coastal waters, the presence of high silicates and less of other nutrient salts and the high turbidity encountered in the coastal waters during certain parts of the year are probably responsible for the meagre fisheries in the coastal waters of the Bay.

It is likely that the profitable fishery grounds are situated more offshore and at greater depths and deep sea exploitation is to be recommended in the waters of the Bay of Bengal.

72. Hydrobiology and fisheries of the Corteljar estuary, Ennur, near Madras, in 1954-55.

P. I. CHACKO, Madras.

Air and surface-water temperature showed identical trends with maxima (96°F and 94°F) in May and minima (74°F and 75°F) in January. Rainfall of 40 inches was spread from June to January when the estuary-water was characterised by high turbidity and low specific gravity. Salinity was high both at surface (30.8—31.0 p.p. mille) and bottom (1.0—32.1 p.p. mille) in June and July, and was low (1.8—1.9 p.p. mille) in December. Marine diatoms (*Coscinodiscus*, *Rhizosolenia*, *Nitzschia*, *Chaetoceros*, *Biddulphia*, *Thalassiothrix* and *Asterionella*) were predominant in April, May and from September to March. Copepods and their nauplii were abundant from June to August. These micro-crustaceans appear to thrive best in this estuary when the salinity is high. To the contrary diatoms swarm when the salinity is low. The fishery was steady throughout the year except in December when adverse conditions prevailed. Catches were however better from May to July. Mulletts (*Mugil oer*, *M. oligolepis*, *M. arsia* and *M. tadc*) were common always, but white-bait (*Anchoviella indica*) and prawns were abundant in September and November respectively. Other species were *Gerres filamentosus*, *Anodontostoma chacunda*, *Therapon jarbua*, *Lutjanus quinquelincaris*, *Platycephalus insidiator*, *Sillago sihama*, *Chrysophrys datnia*, *Etroplus suratensis*, *Leiognathus ruconius*, *L. fasciata*, *Chanos chanos*, *Elops saurus* and *Sciaena albida*.

73. Food and feeding habits of fishes of the pearl-bank, Thollayiram Par, in the Gulf of Mannar.

• P. I. CHACKO, Madras.

The trigger-fish, *Abalistes stellaris* feeds mostly on crabs (*Doclea*, *Pinnotheres* and *Porocellana*), stomatopods (*Gonodactylus*) and small fishes (*Petrocirtes breviceps*, *Alticus bilineatus* and *Percis pulchella*). Foraminifers (*Heterostegina*), medusoids, corals (*Solenocaulon*, *Dendronephthya* and *Spongodes*), broken shells of bivalves (*Modiola barbatus*, *Cardium pulchrum* and *Pinctada vulgaris*) and gastropods (*Natica* and *Cyprea*), scaphopods (*Dentalium octogonum*), tests and spines of echinoids (*Salmacis*, *Temnopleurus* and *Echinocardium*), nullipores (*Lithophyllum* and *Lithothamnion*) and weeds (*Codium*, *Caulerpa*, *Halimeda*, *Sargassum* and *Turbinaria*) are frequently met with in its stomach. In the sea-bream *Scolopsis bimaculatus*, isopods (*Rocinela* and *Cilicaca*), bivalve and gastropod shells and fish-remains are more frequent than other items like forminifers, medusoids and algal-bits. The rock-perches, *Cephalopholis miniatu*s and *Epinephelus undulosus* consume more of prawns and crabs (*Penaeus*, *Periclimenes*, *Alpheus*, *Gonodactylus* and *Doclea*) than shell-grit and fishes. Bits of pearl oyster shells were seen only in three specimens of the trigger-fish. It is more probable that the fishes on the bank perform a useful function in feeding on encrusting organisms. However, more work on the part played by these fishes, especially rays, in the economy of pearl-fisheries has to be pursued.

74. Age and length composition of the catches of the mackereal, *Rastrelliger kanagurta*, off the Calicut coast in 1954-55.

P. I. CHACKO and M. J. MATHEW, Madras.

Shoaling of 0 year-group (6 cm.) commenced in June. In July fish were 11-14 cm., 8 per cent being 1 year old. In August 1, 2 and 3 year-classes (16-23 cm.) were 47, 34 and 19 per cent. In September 75 per cent were 2 year-old ones. In October fresh recruitment of 0 year-group (54 per cent) occurred. In November, peak of fishery, 1 and 2 year-classes were equal, but in December 1, 2, 3 and 4 year-old fish were present in 15, 40, 35 and 10 per cent. In January 82 per cent were 2 year-ones and the rest 3 and 4 years. In February there was another recruitment of 0 year individuals (21 per cent). In March 2, 3 and 4 year-ones were present in 30, 65 and 5 per cent. Appearance of 0 year-group as late as October and February with good percentage of 1-3 year-ones indicated that maturation in Indian mackerel is intermittent and spawning protracted. Mackerels feed on whatever plankton is available in inshore waters though more of copepods and zoo-planktons are taken by adult fish. Food of immature fish is mostly diatoms. *Trichodesmium* is consumed in February and March.

75. Programme of oil-sardine research in Madras State Fisheries Department in 1954-55.

P. I. CHACKO and M. J. MATHEW, Madras.

Twelve lakhs maunds of *Sardinella longiceps* were landed along the west coast. Commercial catches were of 14-15 cm. size-groups in April, 15-16 cm. in May, 16-17 cm. in June, 16-18 cm. in July and 17-19 cm. in August. Fully mature and spent fish occurred in these months. Testis and ovary averaged 14 and 10 per cent of

total weight of fish. In September there was recruitment of new broods (5-8 cm.) and these continued to grow and contribute to commercial catches till the end of the year. Their size progressed to 9-11 cm. in October, 11-14 cm. in November, 12-15 in December and January, and 13-16 cm. in February and March. Feed of mature and gravid fish averaged 1.0 cc. and consisted of diatoms, copepods and cladocerans. Rate of feed of baby-sardines (5-8 sm.) was 0.2 c.c. with diatoms, copepods and dinoflagellates. Though zooplankters are generally favoured by larger sardines,, the composition of the food depends on the nature of the plankton of the inshore waters. *Trichodesmium* is consumed in fair quantities in February and March.

76. On the observation of the existing system of fry-trade in Dhulian.

B. N. MITRA, Chandernagore.

Dhulian of Murshidabad district, situated 174 miles away from Howrah Station, is regarded as one of the important places where fry-trade exists. In order to get a clear and systematic information regarding the existing system of fry-trade, this area was surveyed by the author during recent years before the last devastation caused by the river Padma. Though this area was previously surveyed, very scanty informations were available. During the present survey, a thorough investigation was made with a view to record the following observations :—

- (i) the time of collection,
- (ii) the nature of fry present,
- (iii) the type of net used,
- (iv) the zone of collection,
- (v) the class of catchers, "Beparies" and "Paikars",
- (vi) the method of collection, and
- (vii) the system of fry-trade.

(x) Amphibia.

77. A unique case of an unflexed heart in *Rana tigrina* Daud (Male).

R. P. SETHI, Agra.

In this paper, an abnormality of the heart in *Rana tigrina* Daud has been described. The heart appears as an elongated structure with its various chambers lying one behind the other. The sinus venosus occupies the normal position in the mid-ventral line, but lies posterior to the atria, unlike the normal heart, where it is placed dorsal to the latter structures. The atrial part is considerably enlarged and extends antero-laterally towards the left ramus of the lower Jaw. The ventricle lies anterior instead of posterior, to the atria with its broad base touching the latter, while the narrow apex is directed forwards instead of backwards, and extends up to the middle of the left mandible. Internally the heart possesses the usual structures except that the interatrial septum is oblique antero-posteriorly, its disposition being such so as to establish communication between the sinus venosus and the right atrium only. The heart is surrounded by a very well developed pericardium about twice its normal length which throws light on the problem of flexion of the primitive cardiac tube. The present abnormality is explained as due to the persistent dorsal mesocardium. The vascular abnormalities appear irrespective of the sex of the frog.

78. On the mechanism of respiration in *Rana tigrina* Daud., with a note on its respiratory muscles.

S. M. DAS and V. K. SRIVASTAVA, Lucknow.

Conflicting views regarding the exact mechanism of the buccal and lung respiration have been held in the past, in the Indian bull-frog, *Rana tigrina* Daud. The range of oscillatory movements of the pharynx and the role of various muscles in the act of buccopharyngeal respiration, have not been completely understood. The present contribution contains the results of our observations on the various respiratory muscles and the different respiratory movements, in *Rana tigrina*. To our knowledge this the first time that the respiratory rate of *R. tigrina* as well as the rate of narial movements have been recorded. We have established a definite ratio between the buccal and lung respiratory rates. This ratio is usually constant. The statement usually made in most books, e.g. Grove and Newell that lung respiration is not taken recourse to by the frog, unless there is acute lack of Oxygen is entirely misleading and goes against the established facts.

(xi) Reptilia**79. The Osteology of *Uromastix hardwickii* (Gray).**

BHUPINDER NATH SUD and KRISHAN LAL KHERRA, Hoshiarpur.

The present study concerns the osteology of *Uromastix hardwickii* (Gray). There are eight cervical, sixteen dorsal, two sacrals and twenty four to thirty caudal vertebrae. They are all procoelous. There are no ribs with the anterior four cervical vertebrae, while the posterior four bear ribs. The intercentra or hypapophyses are present in the first six cervical vertebrae and they are also represented in the caudal region, except the first three caudals by chevron bones. In the fore-limb the carpus is composed of nine carpals and the digital formula of the hand is : 2, 3, 4, 5, 3. In the hind-limb the tarsus has got only three bones and the digital formula of the foot is : 2, 3, 4, 5, 4.

In the skull the parietal foramen is situated in the parietal region, not in the fronto-parietal suture. The post-frontals, the supra-orbitals and the lacrymals are wanting. The processus nasalis does not reach the frontal. The prevomers and the pterygoids are separated from each other only by a small part of the palatines. The alisphenoid, the presphenoid and the orbito-sphenoid are absent, but the parasphenoid is represented by a narrow rostrum which projects inwards. The lower jaw has all the six bones on each ramus.

(xii) Aves.**80. The heart and its conducting system in the common Indian Fowl, *Gallus domesticus*.**

RAVI PRAKASH, Bhopal.

The heart of *Gallus domesticus* has been studied with special reference to the impulse conducting tissue. Sinuatrial node, atrioventricular node, atrioventricular bundle and Purkinje fibres are present in the heart of this bird for initiating and conducting the rhythmic impulses for the contraction of cardiac musculature. The disposition of sinus venosus in *Gallus* presents interesting transitional stages in the formation of the mammalian S.A. node in relation with and consequent to

the reduction of sinus venosus. An invagination in the right wall of the chamber has been observed which marks the beginning of a process by which it is ultimately lost in many birds and mammals. A short muscular ridge is present just above the sinuatrial orifice on the right side of the sinuatrial canal. Its disposition indicates that the two precavals and the postcaval veins not only open separately but also directly into the right atrium. In this respect the heart of this bird approaches that of other birds and mammals where the sinus venosus is absent and the three caval veins open separately and directly into the right atrium. It is suggested that the cardiac stimulus initiated at the sinuatrial node travels along set routes from one chamber of the heart to the other. The probable path which the cardiac impulses may follow from the S.A. node to the A.V. node has been described. It has also been pointed out that the Purkinje fibres are important constituents of the impulse conducting system.

(xiii) Mammalia.

81. On the Male Urogenenerative Organs of a local Bat, *Taphozous kachhensis kachhensis* Dobson, (Family Emballonuridae).

S. C. GARG, Delhi.

The kidneys are large and ureters open into the urinary bladder at its dorso-cranial end. The urinary bladder is small and is highly muscular. The urethra could be distinguished into three portions, the prostatic, membranous, and cavernous. The prostatic portion is very well demarcated from the long membranous part of the urethra.

The testes are abdominal, a feature primitive among placental mammals, and they migrate only temporarily, during the breeding season, to the posterior half of the abdominal cavity and never descend in the scrotal sacs. At the anterior end of each testis is a cap-like mass, the caput epididymis, formed by the close coiling of a single narrow tube. From this continues back a thin tubular band which enlarges at the caudal end of each testis to form a U-shaped mildly coiled tubular mass, the cauda epididymis. From the tail end of each cauda epididymis arises the vas deferens which dilates into an ampulla where it enters the seminal vesicle. Arising from the seminal vesicles are the ejaculatory ducts which open into the prostatic part of the urethra by slit-like apertures just in front of the prostatic utricle. The prostate gland situated at the place of commencement of urethra, resolves internally into numerous duct-like lobules which open independently into the prostatic urethra. A pair of Cowper's glands have long ducts which open into the urethra just at a point where the membranous portion passes into the cavernous portion. An os-penis is present and the accessory corpora cavernosa are absent. The penis is pendent and is directed caudally.

(xiv) Embryology

82. Some observation on the foetal membranes of the Indian Civet—*Paradoxurus niger*.

M. A. MOGHE, Poona.

Strahl (1905) described the placenta of *Viverra civetta* (sub-family Viverrinae, family Viverridae) which is the only record of the foetal membranes of a member of this family. It is not an exhaustive paper and no mention is made

in it of the condition of haematoma. No record on the foetal membranes of *Paradoruxinae* is available. The observations recorded in this paper are, therefore, of interest. The amnion is non-vascular except where it is adherent to the inner wall of the allantoic vesicle. The allantoic vesicle is large. Yolk-sac is a shrivelled bag on the mesometrial side. The placenta is zonary and endothelio-chorial as in *Carnivora* (though it is double-disc shaped in *Mustelidae* and is a single disc in *Ursidae*). The haematoma in *Carnivora* are variable and in *Paradoxurus niger*, they are absent. The zonary placenta shows a distinct gap on the anti-mesometrial side. In view of the strong resemblance of this placenta with that of *Procyon*, the two lines of evolution of the *Carnivora*, one including the *Procyon* and the other to include *Vicerridae* suggested by Rau (1925) seem to need revision.

(xv) Cytology.

83. On the multiple sex chromosome mechanism in lygaeid, *Oxycarenus hyalinipennis* (Costa).

P. S. MENON, Delhi.

The paper deals with the chromosome behaviour in *Oxycarenus hyalinipennis* indicating the presence of a multiple sex chromosomes mechanism of the X_1 , X_2 , Y type. This forms the first recorded instance of such a mechanism for the subfamily *Oxycareninae* to which this species belongs. Two sets of diploid complements showing seventeen and nineteen chromosomes respectively have been observed. The resting stages of the spermatogonial cells show three distinct and small heteropycnotic bodies which probably represent the sex-chromosomes. The complement of seventeen chromosomes is seen to be constituted of six large, eight medium and three small elements. In the cells showing nineteen chromosomes, besides the seventeen elements stated, two m-chromosomes are observed. Moreover, it has been observed that m-chromosomes are found only in the cells of some individuals but not in all. These facts combined with their coupling behaviour as observed in the diplotene and diakinesis stages, show that m-chromosomes have not become stabilized as members of the regular karyotype and exemplify a unique instance where the m-chromosomes may be supposed to behave like the supernumerary chromosomes observed in various other insect populations.

84. Observations on the mitochondria of protozoan parasites of man.

P. C. SEN GUPTA and H. N. RAY, Calcutta.

Mitochondria could be demonstrated in the cytoplasm of protozoan parasites of man, viz., the amoebae, the haemoflagellates, the intestinal flagellates, the malarial parasites, and the ciliate *Balantidium coli*, by supravital staining with Janus green B (J.G.-B). The mitochondria vary in shape from minute granules to small rod shaped structures and their size varies according to the size of the parasites. Application of cytochemical methods show that the mitochondria contain simple protein, ribonucleic acid and lipoids and the enzyme alkaline phosphatase could be detected in the mitochondria of some of the parasites.

Specific differential staining of mitochondria by J.G.-B is regarded as due to the presence of cytochrome oxidase—cytochrome *c* system in them, Progressive change of J.G.-B first to a purple dye leuco-J.G.-B, then to pink diethyl saffranine and finally to the colourless leucosafranine, was observed in the mitochondria of almost all the parasites studied. This is due to lactic dehydrogenase and glucose

dehydrogenase enzyme systems; reduced flavoprotein is the immediate reactant which carries out this reduction and therefore any diphosphopyridine nucleotide-flavoprotein system should be capable of carrying out this reduction (Cooperstein and Lazarow, 1953).

Recently cytochrome oxidase, flavoprotein and succinic dehydrogenase have been demonstrated in certain protozoan parasites of man by newer cytochemical methods (Guha, Ray, Mukherjee and Sen Gupta, 1955).

It may be concluded that mitochondria of parasitic protozoa contain enzyme systems that are of importance in Embden-Meyerhof sequence of anaerobic sugar utilisation as well as in reactions of Krebs' tricarboxylic cycle.

85. On the Origin and Morphology of the Golgi Elements in the Male Germ Cells of Ticks as revealed by the Phase-Contrast Microscopy.

G. P. SHARMA, B. L. GUPTA and R. N. CHOPRA, Hoshiarpur.

By the use of a phase-contrast microscope on the fresh testicular material of three species of ticks it has been possible to throw considerable light on the morphology of the Golgi elements and their origin from mitochondria.

It has been observed that the cytoplasm of the earliest primordial germ cell does not reveal any granulation whatsoever, but, as the cell grows, some very fine granules can be clearly made out in it, which are the mitochondria. In the subsequent stages they align themselves linearly to form moniliform threads which become quite smooth in the spermatogonia. A small dark granule can, however, be still clearly distinguished at each end of the individual filament.

In the cytoplasm of the spermatogonia can also be identified some other dark granules which seem to arise by the breaking of an individual mitochondrial filament as a whole or simply by the disassociation of its tip granules. Gradually these dark granules also align themselves linearly to form short and smooth rods which are the precursors of the duplex Golgi elements of the later stages. The details about the actual formation of the Golgi elements from these rods are given in the paper.

86. A Study of the Cytoplasmic Inclusions in the Male Germ Cells of the Freshwater Turtle, *Lissemys punctata punctata* (Bonnaterre).

BHUPINDRA NATH SUD, Hoshiarpur.

The present investigation comprises the study of the cytoplasmic inclusions during the spermatogenesis of the freshwater turtle, *Lissemys punctata punctata* (Bonnaterre). Phase-contrast microscopy has been employed for the study of vitally stained and unstained living material.

The Golgi material show three distinct phases of growth during spermatogenesis. To begin with it is in the form of chromophilic, lipidal granules which later on develop, in their association, chromophobic vacuoles with acidic and watery contents (vacuome of Parat). The lipidal granules are seen adhering to the periphery of the chromophobic vacuoles. The chromophobic vacuoles grow and coalesce and simultaneously with this the lipidal granules associated with these vacuoles disappear and the Golgi material is represented by chromophobic vacuoles alone. Ultimately a single completely hyaline vacuole with denser consistency is formed. This is the pro-acrosome which is bodily converted into the acrosome and the acrosomal remnants are completely absent.

The entire mitochondria form the sheath of the middle-piece. The proximal granular centriole gives off the axial filament and also buds off a ring-shaped

distal centriole. The manchette together with the plasma membrane of that region forms the lateral boundaries of the middle-piece. The enigmatic chromatoid body appears and disappears without any apparent function.

87. Studies on the Zona Radiata in the Oocytes of *Triacanthus brevirostris*.

H. S. CHAUDHURY, Naini Tal.

This paper deals with formation and the structure of the zona radiata in the developing intraovarian eggs of the Teleostean fish, *Triacanthus brevirostris*. It has been observed that the zona makes its first appearance as a homogeneous finely granular layer, between the vitelline membrane and the follicular epithelium around the young oocytes. In this homogeneous layer—the zona pellucida, are formed a number of closely set fine radial lines converting it into a radially striated layer—the zona radiata. In the canalicular spaces between the striations of the zona run fine protoplasmic fibres of the follicular cells and the ooplasmic fibrillar layer. The two sets of fibres consequently differentiate the zona radiata into two concentric zones, a zona radiata externa and a zona radiata interna. It has also been shown that the fully formed zona in *Triacanthus* is partly follicular and partly ooplasmic in origin.

88. Spermatogenesis in the termite king *Odontotermes redemanni* (Wasmann).

D. MUKERJI and BARUNDEB BANERJEE, Calcutta.

Spermatogonial cells, on the terminal zone of the testis are characterised by the presence of deeply stained plasmosome and faintly stained pro-chromosomes within the nucleus. In the prophase the nucleolus is very understained. Chromosomes in the metaphase appear as deeply stained bodies, arranged on the equatorial plate of the spindle. The bivalents on the primary spermatocyte metaphase are also visible clearly.

In Anaphase I chromosomes segregate regularly at the opposite poles, but daughter halves are enclosed within the same cytoplasm. Interkinensis is absent and the daughter halves divide directly once more. The result is that the four spermatides develop as four nuclei within the same cytoplasmic mass. Sperms are also peculiar in that they lack tail and the nucleus is rounded in structure.

89. A pleiotropic gene acting as a rate controlling factor for the ear pigmentation of the Syrian golden hamster (*Mesocricetus auratus*).

ALEXANDER WOLSKY and C. MARY JOHN, Fordham University in New York.

The fur of the normal ("wild") Syrian hamster is dark golden brown on the back and sides with pronounced dark brown markings on the side of the face, and white on the belly. The skin under the fur is pigmented in the regions where the fur is colored and colorless where the fur is white. The skin of the ear is heavily loaded with black pigment and sparsely covered with greyish hair. The "albino" type has white fur and colorless skin all over the body, except on the ears, where the skin is as heavily pigmented as in the "wild" type. Observations were made concerning the time at which these characters first appear. The newborn specimens of both types are without hair cover and their skin is unpigmented. In the "wild" type the pigment in the skin of the body appears two to three days after birth and this time coincides with the beginning of hair growth. The hair on the back and sides is at first pale grey and attains the

golden brown color of the adults on the tenth to eleventh day. The ear pigmentation starts on the fifth day and is completed in about four days. In the "albino" type both the hair cover and the skin of the body remain unpigmented throughout life. The ears also remain unpigmented much longer than in the "wild" type. One month after birth, pigment appears on the ears, but the rate of its formation is much slower than in the "wild" specimens. In three months old "albinos" (which are sexually mature) the ear is not yet fully pigmented and can still be distinguished from the wild type ear. In about six months the difference disappears. Heterozygotes, phenotypically "wild" but carrying the "albino" gene, cannot be distinguished in the rate of ear pigment formation from the "wild" homozygotes. It is inferred from these findings that the pigment formation on the ear of the Syrian hamster is controlled by another biochemical mechanism than the pigmentation (skin and hair) of the remainder of the body. The "albino" gene completely blocks the pigmentation of the body but only delays that of the ear. The gene is thus pleiotropic, that is it has at least two different effects, concerning pigmentation. One effect (on body pigment) has the character of an "all-or-nothing" reaction, the other (on ear pigment) of a rate controlling mechanism. Further studies are proposed to elucidate the biochemical basis of this phenomenon.

90. Cell population in relation to differentiation and organisation.

SIVATOSH MOOKERJEE, Calcutta.

The question of cell population in relation to differentiation and organisation is wide and still open. Idea of constancy of cell population in a morphogenetic pattern within a certain limit of variation, will largely be a speculative index, though the modern trends in morphogenetic hypotheses assume qualitative-quantitative nature of developmental interactions. Recently results have been obtained in the Zoology Dept., Presidency College, Calcutta, to show neural differentiation in ionised chick embryo can take place with less number of cell-co-operation. A degree of neuralised structures now available for cell-population study show the fewness of the developing cells which becomes a characteristic of radiated embryo.

There are some other parallel evidence to show the capacity of differentiation inherent in the individual cell. The isolated, chorda cells separated from the early stage gastrulae and cultivated *in vitro*, are capable of becoming polygonal and vacuolated,—a characteristic of the normal notochord tissue.

Evidence is at hand to argue that differentiation is possible within a certain range without having the normal requisite of embryonic cells. This shows about the certain amount of autonomous morphogenetics of the embryonic cells. However, this autonomic process may not necessarily be related to perfect organisation of the embryo.

91. Process of vacuolisation in Notochord cells.

SIVATOSH MOOKERJEE, Calcutta.

The presence and the behaviour of the notochord cells in the vertebrata embryo are an enigma to the embryologists. The appearance of chorda cells though has been shown to be related to the primary induction, the causes and the process of their vacuolisation are still unknown. An investigation has been undertaken to study the process of vacuolisation in chorda cells. Presumptive chorda cells from amphibian gastrulae in culture as well as in transplantation are capable of undergoing a process of vacuolisation and differentiation.

Before the process of vacuolisation the notochordal cells show rich cytoplasmic basophilic concentrations. The alkaline phosphatase shows positive reaction in the cytoplasm and in the nucleus. The nuclei are Feulgen positive. With the initiation of the vacuolisation, cells enlarge in their relative size. The areas of vacuole formation become negatively charged for basophilia as well as for alkaline phosphatase. Gradually the greater area of the cytoplasm becomes more negative to these reactions. In perfectly vacuolated chorda cells, scanty amount of cytoplasm is found at the periphery of the enlarged cell wall. The nucleus continues to be Feulgen positive. The greater area of the cell cytoplasm shows no reaction for the basophilia and the alkaline phosphatase.

92. Phase-contrast study of the dissociated cells in Hydra.

SIVATOSH MOOKERJEE and SOMES SANYAL, Calcutta.

The technique of isolation of cells invariably renders excellent opportunity to study their physiological behaviour *in vitro*. The cell-constellation of living Hydra has been dissociated by cover-slip-pressure and continued observations under phase contrast have been made.

Majority of the dissociated cells of Hydra round up almost immediately after separation. There is an array of cell-size—large, small and mediate. Endoderm cells are large while the ectoderm cells are more of the smaller size. Interstitial cells are the smallest in appearance. The nucleus in the living state appears as a whitish area in the cytoplasm. The nuclear area often seems to be moving with the churning movements of the cytoplasm. Cytoplasm contains innumerable granules of various shape and size. For the endoderm cells, grannulation seems to be maximum. Cells often show amoeboid movements. The cytoplasmic granules have been noticed to pass out of the cell-membrane. The isolated cnidoblast cells are at the various phases of their nematocyst discharge. The cell wall of the nematocysts maintain their shape and do not round up like endoderm and ectoderm cells after isolation.

93. Cytochemistry of the cell-types in Hydra.

SOMES SANYAL and SIVATOSH MOOKERJEE, Calcutta.

The cytochemical landscape of the different cell-types in Hydra is interesting from the point of view of cell metabolism. Ectoderm and endoderm cells often present contrasting degree of localisation reaction for different substances. D.N.A. content for the cells of the ectoderm is of a higher order than the corresponding picture of the same reaction in endoderm cells. The alkaline phosphatase localisation presents the reverse picture as endoderm cells are invariably rich in phosphatase enzyme than that of the ectoderm cells. The mucoprotein content of the cells shows that ectoderm cells are more reactive and endoderm cells are less positive. The cytochemical reaction of glycogen is still peculiar. Endoderm cells are more positive than ectoderm cells. R.N.A. content of both the layer does not present any marked difference which is uniformly positive in them.

The implication of the cytochemical difference and functional metabolism of cells of the different layers have been discussed.

94. Alkaline phosphatase cycle in the formative cells of the vertebral column in chick embryo.

ASOKE BOSE, Calcutta.

The reaction of alkaline phosphatase in the formative cells of the vertebral column in the chick embryo has been worked out. The mesenchymal cells show

uniformly positive reaction at the early stage of formation. The elements of the perichordal tube and the arches are reactive. However, in their protochordium stage, cells lose the intra-cellular phosphatase reactions and become less reactive. The alkaline phosphatase reaction return to the elements of the vertebral column when the process of calcification and marrow formation in the cells begin. The localisation of the reaction is extracellular in nature. The membranous areas of the vertebral column, i.e., the fibrous intercentrum, some of the packing cells and the interventral regions, exhibit uniform positive reaction from the beginning of the development.

(xvi) Fresh Water and Marine Biology.

95. An investigation of the pollution of the Vellar estuary by waste waters from the South India Starch Products Company Limited at Porto Novo.

R. SRINIVASAN and K. A. DORAI RAJAH, Bhavanisagar.

The pollution of the Vellar Estuary by the waste waters from the South India Starch Products Company, Limited at Porto Novo was investigated in April, 1955. The factory manufactures about 3000 lbs. of starch daily from 12,000 lbs. of tapioca and discharges about 5000 gallons of waste waters daily into the adjacent Vellar estuary. The effluents, if not diluted, are harmful to fish life by their acidity, high biochemical Oxygen demand and high suspended matter. The effluents require a dilution of at least 8000 times for the safety of the estuarine fishery. This dilution is ensured in the estuary throughout the year even during the minimal flow of river water in the summer as at this time of the year the adjoining neritic waters penetrate far into the estuary. In the above favourable circumstances of dilution of the waste waters, no mechanical or chemical treatment of the wastes is considered necessary.

96. Annual variation in the hydrobiological elements of the waters around Krusadai Island, Gulf of Manaar, from April 1954 to March 1955.

P. I. CHACKO, Madras.

Surface and bottom temperatures were high (29.08-30.4°C) in April-May and low (26.0°C) in December-January. Specific-gravity was steady (24.15-24.6) from June to October, but was low (20.0-20.2) from November to January. pH was 8.2-8.4. Visibility was high (2.0 metres) in April and March, and low (1.0 metre) in July, November and December. Surface and bottom salinity showed unimodal fluctuation—maximum (36.31 and 36.45 p.p. mille) in September and minimum (27.85 and 28.00 p.p. mille) in December. Oxygen-content, residual alkalinity and calcium-content showed uniform periodicity. Maximum silicate-content was 125 mg/cubic metre at surface and 140 mg/cubic metre at bottom. Phosphate ranged from 3.0 mg/cubic metre (January) to 62.0 mg/cubic metre (April) at surface and from 4.9 to 67.0 mg/cubic metre in January and April at the bottom. Nitrate was 2.0-52.0 mg/cubic metre at surface and 30.0-55.0 mg/cubic metre at bottom. Phytoplankton was dominant (52.86 per cent) from May to December. Diatoms were constant and *Oscillatoria* frequent. *Trichodesmium* swarmed in May and June causing mortality of local marine fauna. Cepepods were common throughout; *Leucifer* in April, January and March; *Crescis* in March and *Sagitta* in April, May, November, December and January. Fish eggs and larvae, though present throughout, were fair in April and March.

97. Meteorology, hydrography and plankton of the inshore sea opposite the marine biological station, West Hill, Malabar Coast, in 1954-55.

P. I. CHACKO, Madras.

Air-temperature was maximum (89.5°F.) in April and minimum (67.5°F.) in July and December. There was heavy rainfall totalling 138.90 inches. Surface-temperature of seawater ranged from 24.80°C. in June to 29.50°F. in April. pH was uniform, 8.6-8.7. Salinity was high (32.89-33.26 p.p. mille) from December to March and was low (19.70-23.76 p.p. mille) from July to November. Carbonate-content varied from 5.50 mg/1000 in August to 10.35 mg./1000 in October. Phosphate-content was considerable (228.0-257.0 mg./cubic meter) from September to November. Silicate-content showed high value of 104.0 mg./cubic meter in August and low readings (13.05 mg./cubic meter) in October. Standing crop of plankton fluctuated from 20 c.c. per litre in September to 123 c.c. in October. *Coscinodiscus* was present throughout the year, and showed two maxima in May and October. *Biddulphia* was abundant in November. *Chaetoceros* had two peaks in July and December, *Nitzschia* in April and January, and *Fragilaria* in August and December. There was swarming of *Trichodesmium* in March, and of *Noctiluca* in May, August-October, January and February. Copepods had maxima in April and November. *Evaane* was plenty in October.

98. H-ion concentration and flowering of phytoplankton in fish tanks and ponds in Uttar Pradesh.

S. M. DAS and V. K. SRIVASTAVA, Lucknow.

While making some observations on freshwater plankton and hydrological factors which affect their periodicity and fluctuations, it has been observed that a pH maximum corresponds with a peak of phytoplankton and a pH minimum coincides with a peak of zooplankton. The maximum pH value (9.2) reflects indirectly on the dissolved carbon dioxide of the water, since much carbon dioxide is consumed in the process of photosynthesis of the blooming algae. The decline in carbon dioxide is thus associated with an increase in the alkalinity of water. It has been observed that the pH value is comparatively low (7.2-7.4), during the zooplankton peaks. This is because of excess of carbon dioxide evolved by respiration of zooplankton and the lack of its consumption by phytoplankton.

99. Correlations between plankton volume and salts in fish tanks and ponds in Uttar Pradesh.

S. M. DAS and V. K. SRIVASTAVA, Lucknow.

In the course of our investigations on hydrology of fish tanks and ponds in Uttar Pradesh, definite correlations between the plankton volume and phosphate and silicate contents of water were observed. Both phosphate and silicate show a marked increase in the months of July and August, after the rains, but their values decline in the months of February and March. During the latter period there was an increase in phytoplankton *viz.*, Myxophyceae, Desmidiaceae and Bacillareae. The decrease in silicate value is clearly correlated with the abundance of diatoms and desmids and thus an inverse ratio has been observed between silicates and diatoms. On the other hand an inverse ratio has been established between phosphate and myxophyceae.

We conclude that lack of phosphate and silicate (along with the nitrates and nitrites) in fish tanks and ponds indicates paucity of plankton and fish food in

general. This can be easily remedied by using artificial fertilizers and by raising the salt content of the water.

100. A preliminary note on the plankton of Lucknow.

S. M. DAS and V. K. SRIVASTAVA, Lucknow.

In the course of our investigations on freshwater plankton of Uttar Pradesh, we noticed marked variations in plankton volume and percentage composition of plankton from fish tanks at Lucknow. The work done on plankton in India is confined to marine and brackish water forms. Collections were made regularly, from fish tanks with the help of Nansen plankton net, while quantitative sampling was done with a Lea-Gibbon sampler. The first peak in total plankton volume was observed in July, 1954, when there happened a flowering of *Volvox carteri* and *V. africanus*. A second peak was observed in February, 1955 and this was due to the blooming of Myxophyceae (Rivulariaceae). Similarly, the zooplankton showed two peaks during twelve month's collections, the first being in December, 1954, and a second peak in May, 1955.

It has been found that during the periods when phytoplankton attain its peak, zooplankton is at its ebb, and inversely at the times of zooplankton maximum phytoplankton is at its minimum level. This inverse correlation between phytoplankton and zooplankton has been recorded for the first time in fresh water plankton in India in general and in Uttar Pradesh in particular. Similarly, this is the first time that two definite plankton peaks have been demonstrated in fresh waters in India.

SECTION OF ANTHROPOLOGY AND ARCHAEOLOGY

President :—DR. M. N. BASU, M.Sc., P.R.S., D.Phil.

Abstracts

I. PHYSICAL ANTHROPOLOGY

Anthropometry.

1. Human Remains from Pataliputra.

GAUTAMSANKAR RAY, Calcutta.

The excavations at Pataliputra by the Archaeological Survey of India have unearthed some human remains beside other objects of the culture of that period. The human remains are mainly from two places—Bulandibagh and Kumrahar. The human remains of Bulandibagh consist of the following: (1) one skull in nine fragments, (2) fragments of another skull, (3) six small fragments of the maxilla and palate region, (4) half of a broken pelvic bone, (5) one broken clavicle, one fragment of a radius, one metacarpal and a phalange bone, (6) one fragment of a humerus. From Kumrahar came one skull with one orbit broken. In this paper the author has first of all described the steps undertaken by him for the cleaning and reconstruction of the skulls and other bones. And then a comparative craniometric and osteometric studies have been made with such other finds hitherto obtained from other excavations in India.

2. Study of the Physical Characters of the Rabhas of Assam.

BHUBAN M. DAS, Gauhati.

In this paper the author has described the results of the anthropometric survey carried out by him on one hundred adult male Rabhas of Assam.

Of the many tribes of Assam, the Rabhas are occupying the districts of Goalpara, Kamrup and Darrang. Their numerical strength is approximately 84,000 individuals (1941 Census).

This paper deals only with the important somatometric characters. The somatoscopic characters have already been described earlier in a paper published in the *Journal of Gauhati University*, Vol. VI, 1955.

The study reveals that the Rabhas are in majority a mesocephalic, mesorrhine people and falling below medium in stature. The percentage of dolichocephalic persons is also not negligible (being 42%). The mean stature is 162.4 cm. while the mean Cephalic Index and Nasal Index are 76.38 and 78.85 respectively.

Heredity.

3. Twin Dermatoglyphics.

MANISH CHAKRAVARTI, Calcutta.

Dermatoglyphics of fourteen pairs of twins have been worked out according to standard scientific methods. The ridge counts, finger patterns, palm lines and

palm patterns of the two hands have been worked out. The bilateral, homolateral and heterolateral variations have been calculated.

On the basis of earlier work a 30 Per cent homolateral difference in hands has been accepted as the dividing line of criterion of zygotocity of twins. This indicates a probability of correct diagnosis between 84 and 90 per cent.

4. A comparative study of the people of the economically higher class with those of the lower class with particular reference to their reproductive life.

M. L. CHAKRABORTY, Calcutta.

Poor working class people of our country, like sweepers, methors, day labourers etc. exhibit sex function much earlier than the people of higher class with civilisation, education. Their marriage age is less than that of latter group. The working class start their sex life early, maintain sex life for comparatively shorter period, finish early and attain early senility. Want of food, clothings and other worldly responsibilities are no doubt contributory factors for these changes, it has been decided worthwhile to enquire into the influence of hormone in the body, to account for these early changes. The guiding motive for this investigation has been to determine the 17-ketosteroid in the 24 hours urine of the individuals, because 17-ketosteroid has been considered as the "Biochemical index" of testing activity. This determination is expected to reveal at what age the sex hormones start working, which may stimulate sex functions. The values obtained from different persons of different ages, will be correlated with the sex characters, power of reproduction and to find out if there is any reduction in the hormones elaborated in the testis and other endocrines producing early senility. As the stipulated work cannot throw much light on the sex life of a female, the investigation has been kept confined to male individuals only.

Demography.

5. A few Demographic Features of the Christian and Non-Christian Khasis of Urban Area.

M. K. NAG, Calcutta.

Demographic data have been collected by the author from 120 Khasi families of Shillong town. Analysis has been made of sex-ratio, age-composition, family size and composition, marital status, fertility and mortality of the Christian and the Non-Christian groups of the urban Khasis from these data supplemented by some 1951 Census data. It has been found that in spite of gradual conversion of a large number of the Khasis to christianity from the middle of the last century, there is almost no noteworthy difference between the Christian and the Non-Christian Khasis of urban area in so far as the principal demographic features are concerned.

6. Population trend and distribution of the Scheduled Tribes of West Bengal.

B. K. ROY BURMAN, Calcutta.

During 1901-51 total population of scheduled tribes has increased by 70% and during 1891-1951 by 205%. The period of 1891 to 1901 seem to be crucial in the life of the tribals who migrated to West Bengal and reconstruction of the condition of their life at this time is necessary for understanding the subsequent economic,

cultural and social relations of the people concerned. At one extreme, the figures of the Mundas rose by 133% in 1951 from that of 1901 and at the other extreme the Meches showed decrease of population by 53% during this period. The change of other scheduled tribes vary between increase of 39% in case of Lepchas and Bhutias to 65% in case of Santals. Considered by individual decades, Santals, Oraons and Mundas present a trend of stability of population in later decades but in case of others, features of erratic fluctuation continue even now.

The Santals, Oraons, Mundas, and Mrus are widely dispersed all over West Bengal, though greater concentration is on the Western fringe. While the Lepchas and the Bhutias are found almost solely in Darjeeling and the Meches in Jalpaiguri. 98% of the tribal population of the State live in rural areas and only 2.1% in urban areas. For every single urbanised tribal there are eight such persons belonging to all communities of West Bengal. But at one extreme among the Bhutias 31% are urbanised, and at another extreme among Meches they are below 1%. Among other tribes they vary between 1% to 2%.

7. Notes on Wanderings of Birhor Family.

L. P. VIDYARTHI, Ranchi.

The Birhors, a jungle tribe of Ranchi and Hazaribagh District, have been classified into wanderers (Uthlu or Firanta) and settlers (Jangli or Basinda) in order of their mode of living. In the present paper the author, on the basis of his investigation among a few Birhor settlements (Tandla) has tried to examine the demographic and social set up, as well as the nature and extent of migration of the *Uthlu* Birhor.

Intensive investigations at Manjira Tandla is indicative of the fact that though there are nine huts, only three joint families live in the settlement. After marriage each couple occupies a separate hut. Some of their sons cook with their parents and all of them migrate together with their parents. The Tandla consists of two migratory groups which move from jungle to jungle with their scanty belongings and spirit-hut (Bonga-kumba) represented by a basket of palm-leaves or an earthen pot.

The first migrating group, from the stage of inter sub-divisional movement and came to the stage of inter-police-station movement and now it has attained the stage of inter-village movement in the same police station. In point of duration of stay at different places, analysis shows, it varies from one year to five years. The other migratory group, living in the Manjira Tandla, is an example to show how a group from inter-district movement comes to the stage of inter-sub-divisional movement, then to inter-police-station-movement and lastly its movements become confined to the villages of the same police-station.

In the selection of a new site for a settlement (Tandla), three important considerations are made by the Uthlu Birhor. They are, (1) availability of raw materials for rope in the neighbouring forests, (2) nearness to weekly markets to dispose of rope, and (3) the availability of water in the neighbourhood of the settlement.

Nutrition.

8. Investigations into the Nutrition and Dietary habits of the Galongs.

P. N. SEN GUPTA, Calcutta.

An investigation on the diet and nutrition was undertaken among 121 families of the Galongs of NEFA. area in the winter of 1953. The economic

status, food supply, sufficiency of foodgrains, consumption of food groups, preparation and nutritive value of the tribal beverage of *poka*, usages of specific nutrients and growth of children in relation to their nutrition, incidence of goiter etc., were investigated. The results of the investigations on the dietary habits and nutritional conditions of the Galongs have been compared with those of the Padams and Minyongs studied earlier in the same region. Paddy is the only cereal crop raised by the Galongs both by *jhum* and wet cultivations. *Poka*, is exclusively made from rice. The consumption of flesh foods and vegetables are higher in the Galong. Nutritionally Galong diet is better than that of the Minyong and identical with that of the Padam. The growth of the Galong children is better than those of the Minyong and Indian children.

II. PREHISTORIC ARCHAEOLOGY.

9. Observations on Further Finds of Soan Lithic Industry in Potwar.

D. SEN and P. C. DUTTA, Calcutta.

In the proceedings of the 25th Indian Science Congress (1938), a report by the first author on further finds of palaeolithic culture in NW Punjab was published. The collection of implements was lost for some years but was later recovered. In the first report, it was stated that the bifaces as well as the pebble tools and flakes found in the Potwar (Soan valley) and the Indus valley (near Attock) developed within a broad core-tool culture and that the pebble and flakes later became a distinct culture. The present paper gives an account of the main sites and reexamines the relative age and the technique and typology of the pebble and flake tools and of the biface and cleavers in the collection. The sites from which the collections were made are situated on the terraced gravels (T_1 and T_2) of the 2nd. Inter-glacial and 3rd. Glacial phases respectively. The bifaces as well as the more erude pebble and flake tools are dated within the 2nd. Inter-glacial while the more evolved pebble and flake tools are dated within the 3rd. Glacial phase. Both the Early and Late Soan types fall in two distinct groups of pebble and flake tools and are generally free of the biface technique. The pebble tools are either unifacial or partly bifacial and include scrapers and choppers. The flakes are of two kinds—one is characterised by high-angled pebbly or unfacetted platform and the other by low-angled facetted platform. The series of biface and cleavers generally recall the Madras Abbevillian-Acheulian types.

10. Neolithic Industry of Bongara-Bhangat, Manbhum.

GAUTAMSANKAR RAY, Calcutta.

The presence of Neolithic types of implements such as celt, ring-stone, etc. in the district of Manbhum (Bihar State) has already been reported by the author in a paper dealing with the Microlithic industry near the same site and read before the Anthropology and Archaeology Section of the Indian Science Congress at its session in Hyderabad, 1954. The Neolithic objects which were collected then and on an exploration for the second time consist of a number of celts, ring-stones, other objects of stone, perforated stone beads, a few object of pottery and a large quantity of potsherds (coarse and thick in nature). In this paper descriptions of the above mentioned artefacts have been given and a comparison of this Neolithic industry has been made with the Neolithic industries, which have been reported by several workers, from the different parts of the adjoining district of Singhbhum.

CULTURAL ANTHROPOLOGY.**Ethnography.****11) Life in the Hill Village of PEPSU.**

INDERA PAUL SINGH, Delhi.

Villages in the hilly region of the Patiala and East Punjab States Union are small, consisting of 10-12 houses each. Most of the inhabitants in a village are related to each other through a common paternal ancestor, which implies that they belong to one caste. The majority of inhabitants are agriculturists—the owners are either Khas-Rajputs, Kanets or Brahmins. A few lower caste families also live in the village and work as tenants on the agricultural land. Most of them are Chamars of Kolis. In some villages there are no tenants, and hence no persons of lower caste. Each village does not have a Badhi (carpenter), Lohar (blacksmith), or a Julaha (weaver). Each one of them has not enough work in one village, and they cater for 4-5 villages around them.

The caste composition of such villages including the occupation, livelihood, social structure, economic condition of the villagers and their interrelationship etc., which were studied by the author have been described in this paper.

12. A short Note on the Koras of Jamboni, Midnapore.

SHAKTI PRASAD GHORAI, Calcutta.

The Koras are an aboriginal group in the province of West Bengal. They are mainly concentrated in the districts of Midnapore, Burdwan and Bankura. They are an agrarian community and mainly live on agricultural labour. The majority of these people is in shortage of cultivable land. In their social and religious life tribal character is visible though they are in the process of assimilation in the fold of Hinduism. The writer describes the socio-economic condition of the Koras of the village of Jamboni, three and a half miles away from Kesari Police Station in the district of Midnapore.

Social Organization.**13. Outlines of the Social Structures of Bengal and the New Forces of Change.**

TARAK CHANDRA DAS, Calcutta.

Caste is the keynote of the social framework of West Bengal as of other parts of India. Race and occupation are the two most important factors in the growth of caste. Caste operates through connubium and commensality.

Only two out of the four traditional Varnas are found in West Bengal according to orthodox opinion. They are the Brahmins and Sudras. The latter, however, is composed of a large number of castes which have been classified into four groups mainly on the basis of their social relations with the Brahmins who form the pivot of Hindu social system.

The five biggest castes of undivided Bengal are the Mahishyas, Namasudra, Rajbansis, Kayasthas and Brahmins. The Brahmins are concentrated in West Bengal, the Kayasthas in East Bengal, the Rajbansis in North Bengal, the Namasudras in South Bengal beyond Hooghly and the Mahishyas in the western littoral of West Bengal. Together these five castes form nearly 47% of the total Hindu population of undivided Bengal.

Caste-parallels are found in other parts of the world such as Madagascar, Ceylon, Fiji and Burma. But these parallels only show particular elements of the caste system but not the entire institution. Lessons to be learnt from these parallels.

Caste is rapidly disintegrating as the result of the last two Great Wars, the famine of 1943 and the partition leading to a huge exodus from East Bengal. The possible contributions of Sociology and Social Anthropology are in the building up of new social values and new social orders.

14. Directed Cultural Change among the Tharus.

S. K. SRIVASTAVA, Dehra Dun.

The paper discusses 'Directed Culture Change' among the Tharus of Nainital Tarai. Here the author has used the word 'directed' in a different connotation than that was used by R. Linton. According to Linton, "Directed culture change will be taken to refer to those situation in which one of the groups in contact interferes actively and purposely with the culture of the other." But the author has used the term also to mean the situations in which a few individuals from inside the group consciously try to bring some change in the culture of the group concerned. Which in the case with the Tharus, where a group of the Tharus social reformers has been trying to impose the values and ceremonies of high caste Hindus, although the Tharus were described as Scheduled Castes.

This group traces Tharus ancestry to Rana Pratap, the legendary figure of the Rajputs, and identifies themselves with the Kshatriyas, second in the Hindu heirarchical order. Why it does so is hypothetically explained by, (i) the affiliation of both the Tharus and the Kshatriyas to land, (ii) the warrior image of the latter and (iii) confusion in the Kshatriya history. Identification with the Brahmins or the Banias, the first and the third order in Hindu heirarchy is not attempted as the Tharus have neither knowledge nor wealth.

Apart from this conscious effort at culture change, a natural process of acculturation has also affected the Tharus; and they have accepted these changes according to their own socio-cultural needs.

15. Field and Methodology of Research on Caste Structure and Caste Forces in India.

BIKRAM ROY BURMAN, Calcutta.

The constitution of India having visualised the emergence of a casteless secular democracy as the ideal of Indian nationhood, the study of caste set-up has attained the significance of applied science. The writer has enumerated the fields to which the study should be extended, and has suggested that the methodology of study of culture history should be adopted in the above researches also.

16. A comparison of mutual relationships between individuals in Chinese and Indian society in Chamba State and North Malaya.

W. H. NEWELL, Singapore.

In contrast to formal social organisation, informal social organisation does not depend on communal social sanctions. In North India, the Punjab *lah* and the Gaddi *birton* are compared with the North Malayan Teochiu *ganching*. All three informal methods of social organisation use the idea of friendship. The rules governing the relationships between friends are however widely different in the

three cases and the differences in these personal relationships between friends depends on differences in the Indian and Chinese formal social organisation. But whereas in India among the Gaddis the formal social organisation is so well established that there is only room for friendship where there are no other rules of behaviour, among the Teochiu Chinese who have been transplanted from one country to another, the traditional institutions are no longer adequate to guide their conduct and the idea of friendship expressed in *ganaching* covers more of their personal relations.

17. Clan organisation of the Lodhas.

PRABODH KUMAR BHOWMICK, Calcutta.

The Lodhas of Midnapur, an extremely backward tribe, are mostly agricultural labourers and earn their livelihood by sale of forest products. Besides, hunting of games, collection of hides and skins and poultry raising, are their subsidiary occupations. Though sometimes being failure to organise themselves for a better living they indulge in criminal practices. Yet they have been able to establish a compact and dynamic social organisation suited to their own conditions. In this regard they are not backward to any other economically better community of India. The present paper is just a broad study of the social structure of these people.

18. The Garo Family.

BHABANANDA MUKHERJEE, Calcutta.

The marriage and residence rules of the Garos give rise to two kinds of families namely the *nokrom's* and the *chawari's* families. In the former an adjustment of relationship between biological and affinal kins takes place as situation arises out of marriage rules whereas in the latter the relationship is based simply upon biological family only. Functionally *nokram's* family is a socio-economic and religious unit, whereas the latter is a more or less an economic unit. Fulfilment of socio-religious obligations is the responsibility of the former.

19. Garo Marriage and Kinship Organization.

BHABANANDA MUKHERJEE, Calcutta.

In this paper the Garo kinship terms have been analysed with reference to the marriage rules prevalent among them. Sharp distinctions between father and his younger brother, husband's elder and younger brother, and wife's elder and younger sister are the interesting features of Garo kinship terminology. Further husband's elder brother is avoided and respected like own elder brother and wife's elder sister is avoided and respected like mother-in-law.

20. Social Structure of a Chotanagpur village.

SACHCHIDANANDA, Ranchi.

Village communities all over India present certain common features. The structural bonds of a village is quite distinct from the bonds of kin, caste and class. This bond plays a significant role in the socialisation of children and in social control. The different castes and communities living in the village are knit together in an economic, social and cultural configuration based on mutual obliga-

tions, common customs and a common past. Anigara, a village one mile off the Ranchi-Jamshedpur Road presents such structural bonds even though it is inhabited by eight different castes and communities, viz. Munda, Pardhan, Lahra, Teli, Rajput, Oraon, Ahir and Hajam, and cut across by status differences. The village though predominantly occupied by the Munda cannot be put in a class apart from the non-tribal villages in Chotanagpur as it does not differ from them in the mixed character of its population, its technology, its rituals and its economy. It is indeed a part of the rural complex of the area and it gives a general pattern of the villages of Chotanagpur.

21. Problems of Rehabilitation among the Asurs of Netarhat Plateau.

L. P. VIDYARTHI, Ranchi.

In the present paper, the author has discussed about the socio-economic conditions of the Asurs of Netarhat Plateau (Ranchi and Palamau Districts, Bihar State) including the cause of their present poor economic condition. The study is based upon intensive field work in three Asur villages as well as general observations on other twenty villages. Lastly he has put forward a scheme for ameliorating the conditions of this primitive tribe.

The main facts about the author's observations are, (1) though rice is the staple food of the Asur, they do not hesitate to supplement their diet with all types of flesh and fish, roots and leaves, and reach at verge of starvation every year lasting from the month of May to September. (2) 95% of them have taken loan in shape of money and corn from the local Mahajan, and governmental agencies and some of them have also mortgaged their lands. (3) Owing to their irregular diatetic habits and scarcity of drinking water, diseases like diarrhoea, dysentery and malaria take away a heavy toll of life. (4) The poor economic as well as communicational difficulties have also affected the educational status of the Asur.

Diagnosing the causes of their poor plight it has been suggested that originally the Asur were iron-smelters and they had monopoly in the manufacture and supply of agricultural tools in Chotanagpur. But in view of several handicaps they gave up this profession about a few generations back and now they were exclusively cultivators. But as the acreage of land per family is small and as well as their productivity being low, many of the families cannot meet their basic needs simply by eating and selling the products of their land. Poor breed as well as inadequate number of cattle are also among the reasons for agricultural backwardness.

Coming to the question of rehabilitation and welfare of the Asur the author after criticising the Charkha Scheme of the State government which is under implementation has put forward his own scheme. Where he has suggested agricultural improvements and has recommended that familiar crafts like rope-making, tile making, soap making, and industry like lac and iron should be encouraged. Concrete suggestions for the improvement of transport, education, and supply of drinking water, etc., have been made.

22. Crime among the Lodhas of Midnapur.

PROBODH KUMAR BHOWMICK, Calcutta.

How a backward tribe living more or less isolated under social ostracism in a particular geo-physical environment and having a state economic structure leans to crime has been clearly shown in this paper after a thorough field study of the nature and causes of the crimes as found within the Lodhas, a so-called criminal tribe of the Midnapur district of West Bengal.

The author has further demonstrated with facts and figures that how proper welfare and rehabilitational measures can change this tribe from their criminal practices and to become a law abiding community sharing the responsibilities of our growing nation equally with the other advanced communities.

23. Civil condition of the Tribals of West Bengal.

B. K. ROY BURMAN, Calcutta.

Analysis and comparative study of previous census figures have been made. These reveal that it is only at the average age of 22·5 that there are more married than unmarried males; and at the average age of 37·5 that there are more widowers than unmarried. Interestingly enough, widowers outnumber married at the age group 0-5. Among females majority are married at the average age of 17·5; there are more widows than unmarried at the average age of 27·5. As in the case of males, widows outnumber married at the age group of 0-5 and also 5-10, and again at age over 60. The analysis leads to two other conclusions (i) considerable number of widowers after the age of 40 re-marry but comparatively much fewer number of widows do so, (ii) tribal females have comparatively greater longevity than males.

24. Occupation of the Scheduled Tribes of West Bengal.

B. K. ROY BURMAN, Calcutta.

79% of the tribals live by agriculture. But only 28% can depend mainly on own land, 51% carry on mainly by cultivating lands of others either as tenure holders or as labourers. On analysis of district figures the latter class is found to cluster more round industrial belt. Production other than agriculture accounts for 15% of the tribal population. In Howrah, Jalpaiguri and Darjeeling they are 33%, 61% and 39% respectively. In the first they are mostly industrial labourers and in the latter two plantation labourers. Other occupations among the tribals are transport, commerce, agricultural rent receiving, other services and miscellaneous. On sex wise correlation more females are found to be supported by cultivation than males.

25. Raj Mohini Devi—a social reformer among tribals of North-Central India.

L. K. MAHAPATRA, Meerut, and CHANDRABHAL TRIPATHY, Lucknow.

In this preliminary study a descriptive account of the socio-spiritual movement of Raj Mohini Devi has been attempted and a search for causes of the sudden rise and gradual decline of the movement has been undertaken. A comparison has been made with another similar but far from identical movement in Western India and their differential emphasis on social and economical matters has been traced. Some tentative conclusions in the nature of working hypotheses have been formulated, not so much to enlighten, as to stimulate and canalise further investigations. Both the movements show little traces of revivalism; but the western one has much economic orientation even in its revivalistic emphasis on Adivasi-ownership of the ancient land. As happens with most spiritual movements, Raj Mohini Devi had at least a vision, if not a revelation. Her movement compares, *prima facie*, very favourably with the Bhagat movement of the Oraons of Chotanagpore in the recent past. Here is a unique part in socio-religious movements in tribal life, as few women have been credited with such a role, even in the world history.

Religion.**26. The Trend of Recent Changes in the Funeral Customs of the Oraons.**

ARATI SARKER, Calcutta.

In this article, the main traits connected with the death and disposal of the dead among the Oraons have been described from a study of a number of case-histories collected from an Oraon village in the district of Ranchi (Bihar State). The data were collected in the month of January 1953. In order to note the trend of changes (if any) the case-histories were analysed with respect to the periods of occurrences as well as compared with the traits noted by the Late S. C. Roy about a quarter of a century ago.

The analysis actually shows that though the main form of the funeral customs has remained in tact but there is a trend to economise them by a gradual shortening or dropping of some of the elaborate or minor rites.

27. On the Tushu worship of the Mahantas of Mayurbhanj.

BASANTA KUMAR BEHURA, Cuttack.

Tushu worship is prevalent among the many communities of Orissa and other adjoining States. The festival is observed for the whole month of *Pousha* (December-January). An account of the same as observed in Mayurbhanj among the Mahantas is given. Tushu is the goddess of ideal housewife. The image is made of straw and clay and is coloured yellow. She has two women attendants one on either side. On the *Makar sankranti* day (last day of *Pousha*—about the middle of January) and two days following, the immersion ceremony takes place. The procession is headed by young men while the virgins follow behind the image, clad in yellow coloured saris. This is a festival of the unmarried women of the Mahantas and can be compared to the *Kumarotshava* of the Hindus of Orissa.

Material Culture.**28. Korku Dress and Ornament.**

K. P. CHATTOPADHYAY, Calcutta.

In this paper the writer describes the dress and ornament of the Korkus. The children's dress as well as that of adults is described and illustrated with photographs. Tattoo designs are also sketched. The description of ornaments includes those made of grass. The basketry technique used to make these is described and illustrated by sketches.

29. Food and Drinks of the Oraons.

P. C. DUTTA, Calcutta.

It is well known to us that majority of the tribal people of Chota-Nagpur live on a poor diet. But we know very little about the actual condition with respect to food and drinks of any particular tribe of that area. In this paper the author has described the facts relating to the condition of food and drinks of the Oraons based upon actual observations in the field on a number of Oraon families in the district of Ranchi from the end of December 1952 to the middle of January 1953.

The study reveals that the food of the Oraons is very poor both in quantity as well as in quality. The staple food is boiled rice, which is eaten either hot or cold. It is generally eaten either with boiled edible leaves or prepared pulse and salt. Vegetable curry though taken with boiled rice is not common in every day meals. Fish or meat curry is a rare delicacy. Generally the adults, both male and female, take two meals a day, while the children are given three meals a day. Beside the daily food the Oraons are in the habit of drinking home made rice-beer regularly. But this also depends upon the availability of rice which is either the product of their own fields or purchased by working as day labourers.

Museum Method.

30. Cleaning and Preservation of Fire-baked Clay Specimens.

T. C. BAGCHI, Calcutta.

Clay specimens in the museum are mainly of three kinds—Fire-baked (terra-cotta), and Sun-baked and Unbaked. The writer has treated fifteen fire-baked clay specimens, including two from Mohenjodaro, for cleaning and preservation, in the Museum Method Laboratory of the Department of Anthropology, Calcutta University. The specimens were not in a good state of preservation. They were either covered with mud or encrusted with the deposition of salt. The technique adopted for cleaning together with results obtained have been described in this paper.

SECTION OF MEDICAL AND VETERINARY SCIENCES

President :—DR. SUBODH MITRA, M.B. (Cal.), Dr. Med. (Berlin),
F.R.C.S. (Ed.), F.R.C.O.G., F.A.C.S., F.N.I

Abstracts

A. MEDICAL SECTION

MEDICAL AND VETERINARY

1. Summary of some Experimental Observations on Pulmonary Eosinophilia.

S. K. N. SINHA and T. C. GUPTA.

1. Total and differential counts of normal healthy guinea pigs have been done.
2. Total and differential counts done on 3rd, 5th and 10th day after inoculation with serum from patients of pulmonary eosinophilia showed no change in the total counts but exhibited an increase in the eosinophilic counts only on the 10th day. This increase has not been considered statistically significant.

2. Further Radiological Observations on Lung in Tropical Eosinophilia.

S. P. BASU, Calcutta.

Altogether 96 cases of tropical eosinophilia admitted under Dr. R. N. Chaudhuri were radiologically investigated in respect of the lung condition including a follow-up study of 21 patients for a period up to 5 years. The findings are listed below :

- Enlarged hilar shadows :
- Increased striations.
- Diffuse mottling.
- Emphysema.
- 'Snow' storm appearance.
- Pleural thickening.
- Ground glass appearance.
- Active or arrested infiltrations.
- Thickened lesser interlobar septum.
- Normal.

The appearances such as mottling, etc. in the skiagram often do not disappear with the clinical and haematological improvement. Localised broncho-vascular crowding becomes progressively more circumscribed and denser than the initial lesion.

3. Coronary Occlusion (Further study).

J. N. MAITRA, Calcutta.

All the World over it has been said, but statistically not confirmed that this disease, "Coronary Occlusion" has been taking twice the number of all deaths that are taken by both Tuberculosis and Cancer combined. American workers are now

out with 500 cases under Master and co-workers to prevent and cure the malady that is taking the toll in the form of "Sudden Deaths".

The etiology is even now unknown, the writer has classified his cases as idiopathic, nutritional, metabolic and bacterial. Signs and symptoms are those of "Acute and sub-acute abdomen", plus cardiovascular and subjective symptoms of death and dissolution—"Aritha Laksmanam".

Diagnosis depends upon investigation and slow elimination of causes as indicated by signs and symptoms together with finding of physiological normals e.g. blood cholesterol, blood calcium, total count, differential count, prothrombin, bleeding and co-agulation time, ECG—S-T segment at rest and after moderate exercise etc. X-Rays with Cardiothoracic ratio finding and oesophagial shadow to eliminate extra-cardiac complications.

For prevention it is necessary to examine all citizens periodically if any trivial complaints are perceived particularly persons above 40 years.

Cure depends on the progress. If "irreversible" heart and biological tissue changes are detected, then never worry. But if "reversible changes" and local or systemic changes take place the treatment produces result.

4. Incidence of Sciatic Neuritis in Syphilis.

K. C. SAHU, Cuttack.

In syphilis the sciatic neuritis is hardly seen in literature or described in a text book of venereal disease. In this condition the sciatic nerve or the sacral plexus is the seat of interstitial neuritis. It is most frequently observed in young people and is at times associated with arthritis, which may manifest itself in the hip, lumber, spine or sacroiliac joint. There is tenderness of the sciatic nerve. Tenderness of the muscles supplied by the nerve is pronounced. Ankle jerk is diminished. There is no pain in front of the thigh. There is no history of injury, fall or strain. X-Ray examination did not show any abnormality. W. R. of blood and cerebrospinal fluid was positive. Adequate anti-syphilitic treatment with penicillin produced good effect. W. R. became negative in six months time but are still under observation. My series of twelve cases, though not a big group has given the above inference.

5. Clinical Observations on the Incidence of Chronic Allergic Dermatitis in Intestinal Parasitic Infection.

K. C. SAHU, Cuttack.

There are various chronic allergic dermal manifestations observed on the following series of my patients suffering from various intestinal parasitic infections. These are all due to the toxins liberated from the intestinal worms. In amoebiasis there is chronic ulcerations of intestine and secondary bacterial infection sets in. Then there is putrefaction and tissue disintegration. Absorption of the toxic products of the above changes take place and allergic manifestations of the skin occurs.

The production of allergen due to hookworm infection is responsible for development of vesicles and persistent pruritus is due to the toxin of hookworm.

In enterobiasis, the presence of worms locally produces itching, eczematoid condition and pruritus ani occur. Allergic dermatitis of the whole body has been observed in Hookworm and round worm infection. Creeping eruption has been observed. In carrying on the investigations other causes of allergic dermatitis etc. were eliminated. Diagnosis, in each case was established by repeated stool examination by ordinary and in some cases by concentration methods.

Out of 36 cases of mine, one case of eczematoid condition and pruritus and was due to thread worm, two cases of vesicular weeping type of eczema due to hookworm infection, one case of impetiginized dermatitis due to E. H. cysts out of 22 cases of allergic dermatitis 2 cases due to E.H. cysts, 8 cases due to Ankylostomiasis, 3 cases due to Giardiasis were observed. Two cases of Eczematoid allergic dermatitis due to Ascariasis, six cases due to E.H. cysts and one case due to Giardiasis were observed.

6. On the Outbreak of Encephalitis (A new disease?) among Children in Jamshedpur.

S. C. SEAL, Calcutta.

An epidemic of what was initially thought to be a mystery disease but later diagnosed as encephalitis occurred in the town of Jamshedpur during the period between 5th May to 15th September, 1954. Subsequently similar cases were reported from various towns in Bihar, U.P., C.P. and even Punjab, the worst affected towns being Delhi and Lucknow. The peak period was for one month between June 8 and July 9 and the maximum number of deaths (20) was recorded between the 12th and 25th June, 1954. Though the disease was at first thought to have been confined to children population only, investigation led to the discovery of probable cases among the adults also.

Clinically, the disease manifested itself at least in three forms, namely (1) severe toxic or fulminating type, (2) relapsing type and (3) abortive or mild type. On both clinical and epidemiological grounds the disease was considered to be of virus origin resembling Japanese B encephalitis or Australian X type, and some arthropod was suspected to be the vector of the disease. But all attempts to isolate the virus from either the patients or the suspected vectors by the experts of the Poona Virus Research Centre failed. Thus the etiology of the disease having remained unknown the cases had to be divided epidemiologically into three categories, *viz.*, (1) cases, (2) probable cases and (3) possible cases. These were distributed all over the town and even extended to its suburbs. Out of 893 cases which occurred within the period, but could not otherwise be diagnosed, 430 cases were placed in the above three categories *e.g.*, 114 cases in category (1), 67 in (2), and 249 in (3). The total number of deaths was 58 giving a fatality rate of 13.5 per cent, being higher (18.5 per cent) among females than among males (11.3 per cent). Except for 2 cases all deaths occurred among persons below 15 years, the worst affected group being infants and those between 5 to 10 years.

In the absence of sufficient time the author had to utilize whatever opportunities were available to him for carrying out epidemiological investigation in a limited number of cases namely, 140. The results obtained in this investigation have been presented in this paper in the hope that these might be of some use in case of recurrence of a similar outbreak.

7. Erythema nodosum.

N. N. SANYAL, Calcutta.

The present communication refers to three cases of Erythema nodosum with irregular pyrexia admitted to the hospital. Two had suffered from tuberculosis and the other from rheumatic fever and filariasis in the past. The first two responded to cortisone while the third to penicillin alone. The aetiology of erythema nodosum is varied; tuberculous infection was probably the underlying cause in two and streptococcus infection in the remaining one of this series.

8. A preliminary note on the electro-cardiograms in Diphtheria.

J. C. BANNERJEA and A. SEN, Calcutta.

78 early and moderately advanced cases of faucial diphtheria in children of age group 2 to 7 years were studied with serial Electrocardiograms. A total of 185 E.C.G. studied.

Results showed some abnormality or other in 69.6%. Chief abnormalities were. R-waves changes consisted of slurring, notching and low voltage R.

T-wave changes observed were slurring, notching flat topped T, low voltage T.

Depression of ST segment were found in 38% cases and prolonged P.R. interval in 15% cases.

One case of bundle branch block and one of intraventricular block were also found.

Q-T. ratio was abnormal in 43.4 per cent cases.

The possible significance of these results and further line of work is discussed.

9. Biochemical investigation in Kwashiorkor and Marasmus.

K. L. MUKHERJEE and N. K. SARKAR, Calcutta.

Kwashiorkor and marasmus in infants occurring in comparable age periods were studied with a view to find out the difference in the pathogenesis of the two conditions. The dietetic histories were similar, except that the defect was comparatively recent in kwashiorkor whereas it was more long continued in marasmus. There was diarrhoea, marked steatorrhoea and negative nitrogen and fat balances in kwashiorkor, whereas constipation and almost normal fat and nitrogen balances were present in marasmus. The suggestion is made that kwashiorkor is a polydeficiency syndrome, chiefly in proteins and calories. But other deficiencies also contribute their part either directly or indirectly due to steatorrhoeic diarrhoea.

10. A preliminary study on the incidence and frequency of haemophilia in India.

S. S. SARKAR, Calcutta.

In order to find out the frequency and incidence of haemophilia in India a questionnaire was sent to various hospitals requesting them to furnish details of the haemophiliac patients treated by them. 21 hospitals replied to our query, of which 13 have treated no case of haemophilia, varying between the periods of 1-20 years. 8 hospitals have treated 27 haemophiliacs, of which 13 were from the K. E. M. Hospitals, Bombay. The second largest number of 5 cases was from the V. J. Hospital, Amritsar. A few cases from private practitioners have been included in the study.

Attempts to contact each patient either personally or through correspondence were made in order to obtain detailed pedigrees. 11 pedigrees were obtained. One female haemophiliac child has been recorded. The combined hospital and the family data show 34 deaths in a total number of 59 affected ones. The average longevity based on 18 patients has been found to be 11 yrs. 10.01 mos. 14 haemophiliacs were living at the time of the enquiry. 3 haemophiliacs were married showing a total number of 10 children. The incidence of haemophilia appears to show a higher concentration along the western region of the country. Improved diagnostic methods are required, specially to differentiate the other two variants of the classical haemophilia, namely, parahaemophilia and Christmas disease or PTC deficiency, which are believed to be allelomorphic variants of haemophilia.

11. Use of Cyanacetyl Hydrazide in Leprosy.

K. C. SAHU, Cuttack.

Following the reports of the high activity of Cyanacetyl hydrazide in human tuberculosis, this drug under the name Ciazide-50 was given clinical trials in 15 cases of leprosy, in the skin clinic of S. C. B. Medical College, Cuttack. It has been given in the dose of 150 mg. to 300 mg. daily in divided doses and has been found a useful drug for leprosy cases.

In about 25-30 days of administration of this drug, the patient experiences a sense of well being, feeling of reduction of weight, reduction of the size of patches and reduction in the number of lepra bacilli in the field of smears. In one case healing of trophic ulcer was observed. It is well tolerated by patient, efficacious and economical.

12. Synergism of Narcotine-Quinine in the Chemotherapy of Relapsing Malaria.

K. K. CHATTERJI, Calcutta.

Narcotine is a crystalline alkaloid of opium belonging to the phthalide iso-quinoline group of opium derivatives. It holds a low place in the antispasmodic and sedative properties of a series of about 13 opium alkaloids, that explains its new nomenclature α -narcotine.

Some noteworthy medical men and malariologists of tropical experience maintain that in malaria which resists quinine, arsenic and other antimalarials, yield to opium and even better to narcotine which does not produce unpleasant opium symptoms. The author read a paper on this subject at a meeting of the Scientific Section of the Indian Medical Association at which Sir Philip Manson-Bahr presided. He submitted clinical records of cases treated with this antimalarial therapy which showed that there was a reduction in the relapse rates and compared quite favourably with other antimalarials. Sir Philip Manson-Bahr remarked that if a iso-quinoline remedy of vegetable origin could be used with such results, it would certainly be advantageous to synthetic anti-malarials. He also maintained that quinine being the sovereign anti-malarial, its combination with narcotine was a happy one.

13. Effect of Chlorpromazine on Eclampsia—with special reference to reduced maternal mortality in severe form of the disease, and reduced obstetrical shock.

K. DAS GUPTA, Calcutta.

In view of the fact that chlorpromazine has a central depressant action with a marked affinity for hypothalamus and a suppressant effect on the peripheral vascular actions a trial of this drug was undertaken in cases of eclampsia. During the period of eleven and a half months, from 1st October, 1954 to 14th September, 1955, 80 cases of eclampsia were treated with chlorpromazine with some other adjuvants. The total admission of obstetric cases during this period was 9110.

The maternal mortality was 6.2%. Among the 5 fatal cases the cause of death was other than eclampsia in 3. Among the severe eclamptic group there were twenty patients who had more than thirty fits, survived. There were twenty three still births. In twenty out of these, foetal heart sound was absent before instituting the treatment. There were 69 normal deliveries, 18 forceps, 2 craniotomies and one internal podalic version. The obstetrical shock was absent in almost all the cases. In the series of our previous cases where routine modified stroganoff's treatment was given, a good percentage of patient was lost due to this obstetrical shock.

Although it is too early to comment, we can at least presume that this new drug may play an important role in treatment of eclampsia.

14. 'Suramin' as a trypanocidal drug.

H. G. SEN and H. N. RAY, Calcutta.

In this paper we have discussed the action of another trypanocidal drug called 'Suramin'. This drug suffered from a multiplicity of names, namely 'Germanin', 'Bayer 205', 'Moranyl', 'Fourneau 309', 'Belganyl', 'Naphuride', 'Naganal' and 'Antrypol'. Few physiological studies on the mode of action of suramin are available. It is reported to inhibit strongly such enzymes as fumarase, hyaluronidase, trypsin, yeast hexokinase, carboxyamylase and pyruvic oxidase and it has been suggested that it eliminates the trypanosomes by interference with some of the metabolic enzymes (Von Brand, 1952, Lwoff, 1951, Finlay, 1950).

A series of experiments were undertaken in rats by us to study the disappearance rate of the trypanosomes (*T. evansi*) from the inoculation and the cytochemical changes in the organisms after treatment with suramin (15 mgm./kg. intravenous route). The drug exerted its action very quickly and stamped out the parasites from the peripheral circulation usually in 24 hours and rarely in 48 hours. The parasite count began to fall immediately after the start of therapy with this drug as evidenced by the serial counts of the parasites at frequent intervals. The number of dividing forms specially the binuclear ones was observed to be appreciably higher in most cases than the initial count before treatment although the total parasite count was considerably reduced. The nuclei of the trypanosomes divided probably by the stimulation of the drug but the cytoplasm of the parasites failed to divide due to the interference of the drug with the nucleo-protein synthesis. Indiscriminate distribution of the flagella with kinetoplasts and the nuclei without any cytoplasm and cell membrane were seen in the stained film after treatment.

A marked increase of mucopolysaccharides with an appreciable reduction of RNA in the cytoplasm of the trypanosomes was observed as with antrycide therapy. Localisation of alkaline phosphatase, however, in the nucleus, bordering flagellum, kinetoplast and cytoplasm remained unaltered.

The above observations suggest that like antrycide, suramin also had no direct action on the nucleus and the increase of reaction for mucopolysaccharides (heparin like substance) was protective reaction on the part of the organism.

15. Treatment of haemorrhagic Cholera and severe haemorrhagic diarrhoeas.

HEMENDRA NATH CHATTERJEE, Calcutta.

1. Seven severe cases with haemorrhagic stools who showed the Cholera *Vibrio* and *entamoeba histolytica* were treated with the combined therapy of Terramycin and the raw juice of *Coleus Aromaticus*. There was a clinical cure in all cases. Eight similar cases were kept as controls who did not receive Terramycin. Amongst latter, 3 cases died giving a mortality rate of 38%.

2. Another group of 43 cases with haemorrhagic stools and severe diarrhoea were treated with the raw juice of the herb *Euphorbia Pilulifera*. Of these 23 cases showed the Cholera *Vivrio* in stool culture and the remaining 20 cases were culture negative.

3. In all cases (both culture positive and negative), diarrhoea and haemorrhagic stools were controlled within 72 hours (58% within 24 hours, in another 28% within 48 hours and in the rest 14% within 72 hours). The mortality rate was 8% for culture positive cases and 10% for culture negative cases.

4. The action of *Euphorbia Pilulifera* seems to be mainly clinical as it seems to have no action either against *Cholera Vibrio* or *entamoeba histolytica*.

16. Reduction of Cholera Mortality by the control of bowel symptoms and other Complications.

HEMENDRA NATH CHATTERJEE, Calcutta.

It has been possible to substantially reduce the mortality rate of cholera by the help of various remedies for the different signs and complications as follows:

- | | | | |
|---------------------------------------|----|----|--|
| (1) Choleraic diarrhoea | .. | .. | by <i>Coleus Aromaticus</i> with or without Bael |
| (2) Haemorrhagic stools | .. | .. | by <i>Euphorbia Pilulifera</i> |
| (3) Other Associated bowel Infections | | | |
| (a) Acute amoebiasis | .. | .. | by Terramycin cum <i>Coleus Aromaticus</i> |
| (b) Sub-acute amoebiasis | .. | .. | by Bismuth arsenilate cum iodoquinol. |
| (4) Vomiting | .. | .. | by Avomine |
| (5) Dehydration | .. | .. | by Human plasma, pyrrolidone and saline |
| (6) Uraemia | .. | .. | by Combined therapy with Phenergan (intramuscularly) and Vitamin C (intravenously) |
| (7) Oedema of Lungs | .. | .. | by Priscol |
| (8) Inflammatory complications | .. | .. | by Antibiotics |
| (9) Paralytic ileus | .. | .. | by Combined treatment with Neo-stigmine and pantothenic acid. |

17. Incidence of Rh(D) in Cooley's anaemia.

C. R. DAS GUPTA, J. B. CHATTERJEE and R. N. RAY, Calcutta.

Rh typing was done with potent anti-D serum, using auto-serum as diluent in 116 Bengali Hindus consisting of Cooley's anaemia 43, parents of Cooley's anaemia 45, and normal subjects or patients with other diseases 38. The incidence of D-negative was 20.9 per cent in Cooley's anaemia and 13.32 per cent in their parents. In contrast incidence of D-negative in the same racial population was as low as 5.5 per cent in normal subjects or in patients with other diseases.

18. Serum Vitamin B₁₂ Concentration in Normal Indians and in blood dyscrasias.

C. R. DAS GUPTA, J. B. CHATTERJEE, S. K. GHOSH and D. K. BANERJEE, Calcutta.

Vitamin B₁₂ concentration of serum was estimated micro-biologically using *Euglena gracilis* var *bacillaris* as the test organism. In normal Indians mean free vitamin B₁₂ concentration was 53.3 micromicrogram per ml. (range 20-164) and mean total vitamin B₁₂ was 295.5 (range 98-600).

In an average case of nutritional macrocytic anaemia both the free and total vitamin B₁₂ concentrations were low. In uncomplicated iron deficiency anaemia and in aplastic anaemia vitamin B₁₂ concentration of serum was within normal limits. In dimorphic anaemia the concentration was variable depending on the relative proportion of deficiency factors; in four out of ten cases, vitamin B₁₂ concentration was below the normal range; in the remaining six cases it was within normal range.

In chronic myeloid leukaemia the concentration was in general higher than normal. In one case of erythroleukaemia, a very rare disease, the vitamin B₁₂ concentration was also high.

19. A functional study of Nutrition among the Mundas of Bihar. Part I—Extensive Studies.

N. P. RAO, Lucknow.

Field investigations have been conducted at selected areas in Khunti Sub-Division, (predominantly inhabited by Mundas) Ranchi District, Chotanagpur Division with a view to (a) appraise some broad aspects of the existing condition of tribal food habits in relation to their rural life and living, (b) estimate quantitatively their dietary status in the light of data vis-a-vis their social and cultural structure. Some useful "reconnaissance" or "pilot" observations were made during the survey with particular reference *inter alia* to the degree of variation in the nature of food taken and its weight, procurement, storage and preparation of food, ceremonial drinks and annual ceremonial hunt and distribution of the game.

20. A functional study of Nutrition among the Mundas of Bihar. Part II—Intensive Studies.

N. P. RAO, Lucknow.

In Part I of this series is described quantitatively the broad aspects of the existing condition of food habits of Mundas in Bihar in relation to their rural life and living. In this Part are described the results of attempts made for quantification of the data pertaining to the above problem, and the more important steps involved in the study of this problem. Outlines of intensive studies carried out, the methods adopted and the type of data collected on the subject have been discussed.

21. Antibiotics in animal nutrition.

D. BANERJI, Calcutta.

Growth promoting effect of four different dosages of aureomycin, two of penicillin, one each of streptomycin and chloramphenicol was studied on guinea pigs kept on natural though inadequate diet. Rabbits were similarly investigated with different dosages of aureomycin. There was no statistically significant difference in the weights of the experimental and the control groups of animals after 12 weeks of experimental period, during which both the groups gained in weight by more than 400 per cent of the original weight.

21A. Effect of prolonged milk diet on our Laboratory mice.

N. K. ROY and A. N. BOSE, Calcutta.

Absolute milk diet or addition of it in the usual dietary is unfavourable for the growth of *P. berghei* blood induced infection in our inbred laboratory white mice. The intensity of activity increases with the length of period, the animal is kept on milk diet before inoculation. But too long a period on milk diet, deprives the animal of that protection. Temporary depletion of the essential metabolite for the growth of the parasites is perhaps made good by gradual adaptation of the host to the changed circumstances, which responds by synthesizing the metabolite for the growth of the parasites, from simple stuff. This apparently paradoxical phenomenon may supply some explanation for high incidence and mortality from malarial fever, amongst the year-long undernourished population in the malarial zones in our country.

22. Treatment of Rye seeds (*Secale cereale*) with Indole acetic and Indole butyric acids.

SALIL KUMAR CHATTERJEE, Darjeeling.

The effects of pre-sowing treatments with Indole acetic acid and Indole butyric acid on the germination of Rye seeds (*Secale cereale*) have been followed from the day of sowing till the development of healthy seedlings. In addition, growth and development were followed by noting the total no. of leaves per plant at the time harvesting, total number and length of tillers (cm) per plant and fresh weight of mature ears per plant in grams.

Seeds were soaked for 25 hours at room temperature in the last week of September 1954 in 10, 50 and 100 ppm. solutions of Indole butyric and Indole acetic acids. A control was kept where equal number of seeds were soaked in distilled water for the same period. After the period, seeds were sown in loose prepared soil under normal field conditions.

In all the treatments of indole acetic acid (10, 50 and 100 ppm.) and in the lowest concentration, 10 ppm.) of indole butyric acid an acceleration in the rate of germination was noted. In higher concentrations of I.B.A. (50 and 100 ppm.) the total percentage of germination of seeds leading to normal healthy seedlings was inhibited and the inhibition was proportional to the concentration. Pre-sowing treatments with I.A.A. increased total percentage of germination in all the concentrations. The enhancing effect on germination was however most prominent in lowest concentration of I.B.A.

As regards the effects of hormones on ultimate growth of the mature plants indole butyric acid in the concentration of 10 ppm. showed a distinct increasing effect over the controls. Indole acetic acid also induced accelerating effects in the concentration of 10 ppm. but other two concentrations were not clearly effective.

In conclusion it has been stated that during the early stages of germination rapid production of auxins takes place from the stored inactive precursors. During these stages the supply of additional active auxin from an external source may be expected to accelerate the growth rates above the normal, provided the concentration does not reach beyond the optimum. And such pre-germination treatment may radically effect the subsequent development of the plant. In the present investigation pre-sowing treatments of seeds produced, in some concentrations of hormones, an enhancement of ultimate growth. Although the convincing proof is still needed, such phenomenon have come to be connected in the minds of physiologists with the hormone balance of the seed, and if such is indeed the case, supply of auxin to seed might easily modify the maturation requirements.

23. Urticarial Skin Lesion : Identification of the Nature of Chemical Substance at the Site and its Estimation.

M. L. CHATTERJEE and A BANERJEE, Calcutta.

There are different views regarding the nature of the chemical substance present at the site of an allergic urticarial wheal. The generally accepted view favours the theory of liberation of histamine or H-substance, but there are also other views concerning liberation of acetylcholine, and a defect in the production of cholinesterase and histaminease. The present investigation relates to the study of the nature of the chemical substance present in the extract of the skin of an urticarial wheal.

Extract of skin prepared after Feldberg and Talesnik was tested on isolated guinea pig ileum in magnesium free tyrode solution in presence of the specific antagonists viz. atropine and mepyramine. Approximate quantitative estimation of the content of the chemical substance was also made. The present experimental

findings show the presence of histamine at the site of urticarial lesion to be at a much higher concentration (3.5 times) than that found at otherwise normal areas of skin.

24. Hepatic structure and function in Kala-azar.

P. C. SEN GUPTA, B. DAS GUPTA and H. N. RAY, Calcutta.

Hepatic tissue obtained by needle biopsy from 14 cases of untreated or resistant kala-azar, in which tests of hepatic function were carried out, was studied by histological and histochemical methods. Evidence of hepatic dysfunction, viz., altered albumin globulin ratio, increased gamma globulin content, increased prothrombin time, high values for thymol turbidity test, was present in all the cases. The degree of proliferation and parasitisation of the Kupffer cells showed wide variation in different cases. The degree of parasitisation could be classed as intense in 5, moderately heavy in 4, mild in 2 and slight in 3 cases. In a few instances foci of parasitised and non-parasitised histiocytes with lymphocytes and plasma cells were seen in the substance of the liver.

The pattern of hepatic lobule was altered in cases showing marked proliferation and swelling of the Kupffer cells. The parenchyma cells of the liver showed varying degree of degenerative changes, viz., inequality of cells and their nuclei, balloon cells, more frequently in cases showing moderate to heavy infection; slight fatty changes were found in 3 cases only. In the cases with light infection the liver cells were normal. Granules of bile pigment, lipofuscin, calcium, were found in the parenchyma cells in many of the cases. The portal tracts often appeared more cellular and contained parasitised histiocytes, lymphocytes and plasma cells. The sinusoids were congested in most of the cases. Early cirrhotic changes were found in one case and slight increase of fibrous tissue in another.

In the cases showing moderate to heavy infection and one with mild infection, depletion of polysaccharides from liver cells was noted. In cases with mild infection generally the glycogen content—appeared to be normal. Feeble reaction for polysaccharides was noted in the leishmania in a few heavily infected cases.

The pattern of reaction for alkaline phosphatase was more or less normal in majority of cases. The leishmania showed strong reaction in the nucleus and distinct reaction in the kinetoplast and the body wall; the cytoplasm showed relatively weaker reaction.

Biochemical evidence of hepatic dysfunction was present in all the cases, but there was wide variation in histopathological picture—indicating lack of correlation between functional disturbance and the structural and cytochemical changes noted.

25. Pigment in Trypanosomiasis of Guineapigs.

H. G. SEN, A. M. MUKHERJEE, H. N. RAY and G. SCHYNOLL, Calcutta.

Records of pigment production in trypanosomiasis have been encountered by Fiennes (1952) in the kidney and lymphatic gland of cattle suffering from chronic infection with *Trypanosoma congolense* and *Trypanosoma vivax*.

During the course of our studies on pathology of guinea-pigs, experimentally infected with *Trypanosoma-evansi*, pigments in the form of granules of varying sizes were seen to be present in the spleen tissue. With haematoxylin and eosin stain these granules took dark brown colour. The disease due to *T. evansi* infection in guineapigs usually ran a chronic course with the intermittent crisis and severe anaemia leading to the fatal termination in 1 to 2 months. The studies on autopsy revealed marked enlargement of the spleen associated with congestion. Microscopically the normal architecture of the spleen was found to be altered. The red

pulp showed marked proliferation. That these granules were haemosiderin pigments were determined by specific test which gave positive reaction for iron.

The presence of haemosiderin pigments in the spleen tissue suggests the destruction of erythrocytes by the macrophage cells and indicates a probable relation with the metabolic disturbances which are a feature of the disease.

26. Effect of β -irradiation of the gastric mucosa in dogs.

S. R. MUKHERJEE, Calcutta.

In eight dogs the gastric mucosa was irradiated with a new type of β -ray applicator consisting of a spherical airfilled balloon with a central source of radio-phosphorus.

There was very little evidence of morphological changes in the gastric wall, but a significant fall in the acid secretion resulted from irradiation.

The details of the technique will be described.

27. The arterial supply to the human 'Gubernaculum Testis'.

S. S. BASU, Madras.

Fresh male foetuses (arteries specially injected) varying from 18 cms. to 22 cms., C. R. lengths have been dissected under dissection microscope.

The arteries supplying the gubernaculum are derived from two sources :—

(1) The testicular artery sends one branch which courses downwards and forwards and descending near to the lower pole of the testis, medial to the globus minor, gives a branch to the lower pole of the testis, and then the artery enters the substance of the gubernaculum and runs downwards in a tortuous manner. This artery to the gubernaculum usually gives one or two small branches to the commencement of the Vas deferens.

(2) The inferior epigastric artery gives origin to a branch which after a short course divides into two branches, one of which curves upwards to reach the gubernaculum and within its substance the artery, while running upwards, ramifies into smaller branches.

The arterial supply to the gubernaculum in the male is in conformity with the arteries supplying the round ligament of uterus, both in foetal stages and in adult females.

The origin and distribution of the arteries which supply the gubernaculum have not so far been mentioned in the available literature.

28. A Comparative Study of the Relative Frequencies of the Different Mitotic Stages with some of their Abnormalities in the Non-neoplastic and Neoplastic Tissues of Human Uterine Cervix.

G. K. MANNA, Calcutta.

The present paper is a continuation of the previous one (Proc. 41st. Indian Science Congress, Part III, Pp. 216, 1954). A comparative study of the relative frequencies of cells in different stages of mitosis to encounter twenty anaphase cells from each of the eight non-neoplastic and eight neoplastic human uterine cervix tissues has been made. The proportions of the different mitotic stages in the eight non-neoplastic cases, are : anaphases 160; prophases 251; prometaphases

133; metaphases 535; and telophases 68; for the same number of anaphases cells from the eight neoplastic cases the relative frequencies of the other stages are : prophases 249; prometaphases 399; metaphases 2982; and telophases 125. The significance of this result has been discussed.

The frequency of various types of chromosome abnormalities in metaphase and anaphase stages of mitosis in the above cases has also been studied. In the non-neoplastic cases, out of 535 metaphases, 5 plates with hollow spindle, 48 with multipolar spindle, 2 with C-mitosis and 69 with lagging chromosomes have been observed. In the neoplastic cases on the other hand, out of 2982 metaphases, 24 plates with hollow spindles, 125 with multipolar spindle, 82 with C-mitosis, 343 with lagging chromosomes are observed. Out of 160 anaphases of each non-neoplastic and neoplastic cases 33 plates in the former and 49 plates in the latter have been found to have some abnormality with the division of the chromosomes. The possible significance of this result has been discussed in the light of the numerical variation of the chromosome number in the normal as well as cancerous tissues of man.

29. Experimental production of splenomegaly in rats.

T. K. SAHA, R. N. CHAUDHURI, Calcutta.

Gradual occlusion of the portal vein was produced by wrapping a piece of cellophane paper around the portal vein of a series of albino rats, weighing from 150–175 grms. As a result the spleen was enlarged 3 to 4 times the original size in 6 out of 18 rats within a period of about three months. In the remaining ones there was evidence of extensive collateral circulation between the portal and systemic veins which might possibly be a factor in combating the rise of portal tension. Splenoportal venography done in three cases showed complete occlusion of portal vein at the point of cellophane wrapping with or without dilatation of splenic vein and visualisation of dilated tributaries. Histological examination of the spleen showed thickened capsule and trabeculae, dilated and congested sinuses and proliferated reticuloendothelial cells in some cases.

30. Human Intestinal Bacteriophage—part 3. Behaviour of Coliphage CVX-5 in Synthetic medium.

B. M. GUPTA and M. SREENIVASAYA, Lucknow.

A bacterial virus isolated from a patient of colitis was reported earlier. Its morphological, cultural, host range, and stability characteristics were studied later. The behaviour of the virus in a chemically well-defined lactate medium has now been investigated.

Our studies show that in the lactate medium the virus is relatively unstable as compared with its stability in the nutrient medium.

In the ammonium lactate medium the virus cannot be stored very long as one finds if it were stored in nutrient medium. The yield of the virus obtained in synthetic medium is somewhat lower. When such a medium is supplemented by a single amino acid tryptophane, the lysis of host cells by the virus is more extensive than when no tryptophane is added. Adsorption of the virus to host cells can take place even in the absence of tryptophane.

Using this synthetic medium it was possible to undertake a preliminary investigation into the nature of resistance offered by a laboratory strain of resistant *E. coli* isolated from infected bacterial plate. Results show that cells of resistant host do not permit the adsorption of the virus to the cell wall.

31. *Anisochilus carnosus* in the anaphylactic reactions of Guinea pigs.

M. SIRSI, Bangalore.

Fresh juice of *Anisochilus carnosus* (Syn : Ajapada ; Thick leaved lavender ; Panjari-ka-pat ; Karpuravalli ; Doddapatre) is used in indigenous medicine to relieve severe cough, itching and dermatoses in liver affections and in other allergic manifestations. Pharmacological investigations have shown that the essential oil of this plant possesses 'in vitro' musculotropic and neurotropic antispasmodic activity, antihistaminic and slight local anaesthetic action. This communication deals with the 'in vitro' effect of the oil on the anaphylactic reaction of sensitised guinea pig uterus and intestines.

The antigen for specific sensitization was the fresh white of an egg. Incubation period allowed was 3 weeks. Schultz-Dale reaction in presence of various concentrations of the oil using different pieces of sensitized uterus and ileum indicated :

- (1) the essential oil from the leaves and stem of the plant, though possessing 'in vitro' antihistaminic property does not inhibit the anaphylactic response of the sensitized uterus, and,
- (2) the oil diminishes spontaneous movements, causes relaxation of the intestinal musculature and completely inhibits the contracture due to the antigenic stimulation of the sensitized ileum.

The possibility of the oil being useful in intestinal allergic manifestations is mentioned.

32. Effect of *Rauwolfia* alkaloids on Biliary secretion in dogs.

C. RAMPRASAD and M. SIRSI, Bangalore.

Though bile is secreted continuously even in the absence of any nerve connections, as shown by the isolated perfusion experiments on liver, in the animal body, the quality and quantity of bile secretion is influenced by the secretory and inhibitory fibres of the parasympathetic and sympathetic systems respectively.

Prior to the use of *Rauwolfia* alkaloids, in fairly large doses over a prolonged period, as is now being advocated—more so after the advent of parenteral therapy—it is essential to understand the functional derangements likely to occur, as they have already been shown to exert antidiuretic effect and interfere with the oestrus cycle.

The influence of crude total alkaloids and Reserpine (Serpasil, Ciba, injectable form), on the biliary secretion in anaesthetised dogs has been studied.

Crude total alkaloids (C.T.A.), 5 mg./kg., caused an immediate reduction in bile volume, which persisted over a period of two hours, and in few animals did not regain the original value even at the end of 4 hours. An intimate relationship between the rate of flow of bile and the fall in blood pressure was noticed.

Reserpine, 1 mg., and 2 mg., doses, caused a slight transient reduction of biliary secretion. Neither the C.T.A. nor reserpine exhibited any antagonistic effect to the normal choleric action of sodium deoxycholate.

The possible modes of action of these alkaloids in the biliary hyposecretion, has been discussed.

33. Pharmacological investigations of an antiarthritic drug from *Polymnia uvedalia* Linn.

S. C. DATTA, Calcutta.

The resinous portion of the extract from the plant *Polymnia uvedalia* Linn. was investigated for its antihyaluronidase properties in order to determine if it

possessed anti-arthritic activity. The test depends upon the suggestion that the inflammatory processes are associated with the hyaluronidase imbalance in the body and that the beneficial effects of substances like cortisone are due to their ability to inhibit hyaluronidase. In order to determine whether it possessed such properties, experiments were performed *in vivo* and *in vitro*. The *in-vivo* tests showed that when India ink was injected intracutaneously in rabbits and guinea-pigs, it remained confined to a spot and did not spread out over a large area in the form of pseudopodia as hyaluronidase splits hyaluronic acid, a mucopolysaccharide component of intercellular binding cement of connective tissues in the body. When a mixture of hyaluronidase, India Ink and the extract of the plant were mixed together and injected intracutaneously, there was little or no spread, thus indicating the property of the extract to inhibit hyaluronidase action. In the case of guinea pigs, the extract of the plant was injected intracutaneously. Spread did not occur, thus indicating that the extract of the plant acts as a hyaluronidase inhibitor, even when injected intraperitoneally. *In vitro*-test with the aqueous extract of the plant, however did not show much activity, which indicate that the drug action takes place through some system in the body. Preliminary experiments on inducing arthritis in rats were performed by the injection of formalin and mustard and when these rats were treated with the extract of the plant, they showed marked improvement.

34. Antiveratrinic action of Dilantin Sodium, Procaine Amide and Quinidine.

R. B. ARORA, Jaipur.

56 Experiments were done on the Sartorius muscle of frog suspended in twin chambers in bicarbonate buffer solution. Supermaximal shocks (40 volts, duration 0.5 millisecond) were applied to the muscle in the bath fluid by a Grass Stimulator delivering Square waves. Veratrine response was produced by Veratridine 1 : 10,000,000.

Procaine Amide and Dilantin Sodium were compared with Quinidine for their antiveratrinic activity. It was found that Procaine Amide is Qualitatively similar to Quinidine but Quantitatively 1/5th as potent in its antiveratrinic property. Dilantin Sodium on the other hand differed Qualitatively from Quinidine and procaine Amide in its inability to prevent the development of veratrine response and was found to possess 1/10th the activity of Quinidine.

These results when considered with the previous findings of the author and those of Winbury and Hammer, 1955 J.P.E.T. and Harris and Kokernot, 1950, Am. Journ. Physiol. suggest that a parallelism exists between the Antiveratrinic and Antifibrillatory action of drugs.

35. Antiveratrinic and antiarrhythmic activity of Ortho substituted benzoic acid ester of dialkylaminoalkanol (McN-29-A-11) a new local anaesthetic.

B. R. MADAN, V. N. SHARMA and R. B. ARORA, Jaipur.

The effects of a new local anaesthetic McN-29-A-11 were investigated for its antiveratrinic activity and on auricular arrhythmias. Results were compared with quinidine. Acute toxicity study was also done.

The effect on veratrine response was studied according to the technique of Arora and Krayner. Atrial flutter was produced by the injury-stimulation method, atrial fibrillation was produced by direct application of (1) Acetylcholine and (2) aconitine on S.A. node. The effects on refractoriness and conductivity were observed by O-T and P-Q intervals respectively from the electrocardiographic tracings recorded by Grass Inkwriting Oscillograph.

McN-29-A-11 prevented veratrine response in the concentration of 1:300,000, and is three times stronger than quinidine.

McN-29-A-11 and quinidine reverted auricle flutter at an average dose of 8 mg/kg and 21 mg/kg respectively. In auricular fibrillation the average dose of McN-A-11 was 11.8 mg/kg and that of quinidine was 16 mg/kg. The new drug produced less slowing in the rate of conduction than quinidine.

The acute intravenous toxicity of McN-29-A-11 and quinidine in albino mice was 25.4 mg/kg. and 56 mg/kg respectively.

This drug seems to be a potentially useful drug in auricular arrhythmias and myotonia congenita and deserves clinical screening.

36. Quinidine-like activity of pamaquin.

R. B. ARORA and B. R. MADAN, Jaipur.

Substances containing the $-\text{CH}_2-\text{CH}_2-\text{N}(\text{C}_2\text{H}_5)_2$ group have been reported in the literature to possess quinidine-like action in arrhythmias. Since pamaquin possess this chemical group, it was adduced that it may also exhibit quinidine-like activity and hence the present investigations were undertaken. To give more confidence to the results and their interpretations, tests were made only on established arrhythmias: (a) Auricular flutter produced by injury-stimulation procedure and (b) auricular fibrillation induced by the topical application of: (i) 0.05 per cent aconitine and 5 per cent acetylcholine in anaesthetised dogs. In addition, a comparison of pamaquin and quinidine was made on the electrocardiogram of cats.

The results obtained indicated that:—

- (1) Pamaquin and quinidine both caused a decrease in auricular flutter rate followed by an abrupt reversion to sinus rhythm at an average dose of 4 mg/kg and 21 mg/kg respectively.
- (2) Average fibrillation-combating dose in aconitine-induced arrhythmia was 8 mg/Kg with pamaquin, while the same for quinidine was 18 mg/kg.
- (3) In acetylcholine-induced auricular fibrillation pamaquin showed an activity equivalent to that of quinidine.
- (4) Analysis of electrocardiographic data revealed that pamaquin caused greater slowing of conduction rate and more lengthening of refractory period. The former one is unfortunately a very deleterious property of pamaquin, because in the presence of conduction defects it might precipitate fatal ventricular fibrillation, which precludes it from being a drug of possible therapeutic usefulness in auricular arrhythmias.

37. A study on the chemical structure of cinchona alkaloids and cupreines responsible for its negative Ionotropic action in isolated Amphibian and Mammalian hearts.

R. B. ARORA and S. L. AGARWAL, Jaipur.

Sixty experiments were conducted on isolated perfused amphibian and mammalian hearts to establish the chemical configuration of cinchona alkaloids and cupreines responsible for their negative ionotropic action.

It was observed that like the cardiac glycosides and aglycones (Arora and Krayer —106, 371; 1952 and Arora, 108, 26; 1953, Jour. Pharm. and Exp. Therap.), the cardiac activity of cinchona alkaloids and cupreines is based on the same stereochemical and chemical requirements as their antiveratrinic activity (Arora, April, 1955, Ind. Jour. Med. Res., and Arora and Dandiya to be published).

38. Antiarrhythmic activity of *Nardostachys jatamansi*.

B. R. MADAN and R. B. ARORA, Jaipur.

Volatile oil, active principle of *Nardostachys jatamansi*, an indigenous Indian drug, was investigated for its antiarrhythmic activity. The experimental procedures for inducing arrhythmias were :

- I. Isolated rabbit auricles,
- II. Auricular flutter produced by the method of injury cum electrical stimulation.
- III. Aconitine and
- IV. Acetylcholine-induced auricular fibrillation in pentobarbitalized dogs.,
- V. Digitalis-induced ventricular arrhythmias.

Also, the effects on the conduction and refractory period were studied by measuring the P-Q and Q-T intervals in the electrocardiogram of cats.

In each case quinidine was used as standard for comparison.

The results obtained in this study indicated that *Nardostachys jatamansi* was inferior to quinidine in its antiarrhythmic activity. But it scored significant advantages over quinidine in four important respects :

- (1) Its intravenous toxicity, LD 50 in mice was 80.3 mg/Kg. as against 55 mg/Kg. of quinidine.
- (2) It caused less slowing of conduction than quinidine.
- (3) Its hypotensive effects were less marked.
- (4) Quinidine exhibits a marked negative inotropic action and seriously interferes with the force of contraction of the heart when given in a dose sufficient to abolish fibrillation but *Nardostachys jatamansi* did not have marked myocardial depressant action.

With these facts in view, it is suggested that this ancient herbal preparation does show sufficient promise to warrant clinical trials.

39. The effect of Adrenaline, and Nor-adrenaline on the cardio-vascular effects of thiopentone.

P. K. DAS and R. B. ARORA, Jaipur.

Experiments were conducted on 32 anaesthetised dogs with S-A and A-V nodal rhythms with a view to find out the resuscitative value of sympathomimetics on the deleterious cardio-vascular effects of thiopentone. Thiopentone 5 to 10 mgm/Kgm, and adrenaline and nor-adrenaline 2 to 5 mcgm/Kgm were administered intravenously. Continuous intravenous infusion of adrenaline and nor-adrenaline was given at the rate of 0.20 to 0.40 mcgm/Kgm/min. by Straub's continuous infusion machine.

The reappearance of P wave due to adrenaline in A-V rhythm was not seen when it was given following thiopentone administration, showing cardio-depressant effect of the latter.

Thiopentone did not block the cardio-accelerator response of adrenaline, but the latter could reduce the cardio-depressant effect of thiopentone. Thiopentone reduced the pressor response of adrenaline and nor-adrenaline. But hypotensive effect of thiopentone could be reduced by simultaneous administration of adrenaline or nor-adrenaline, or its administration during continuous I.V. infusion of nor-adrenaline. These findings establish the resuscitative value of these sympathomimetics in C-V catastrophies during thiopentone anaesthesia.

The depressor response of adrenaline, when it was present, was more prolonged when given after thiopentone administration. Thiopentone showed prolonged hypotensive effect when given during continuous adrenaline infusion. It appears that thiopentone facilitates the vasodilator component of adrenaline.

40. Bactericidal and Fungicidal action of Neem leaves.

S. P. BANERJEE and P. K. SANYAL, Calcutta.

In the present study both *Azadirachta indica* A. Juss (ordinary neem) and *Melia azedarach* Linn (Ghora neem) have been used.

The bitter principle of Neem leaf, *Azadirachta indica* A. Juss has been found to be a glucoside whereas the leaf of Ghora neem, *Melia azedarach* Linn is practically bitterless and glucoside is absent. The glucoside is soluble in water, alcohol and chloroform but insoluble in ether and petroleum ether. Alkaloid is absent in both the leaves but both of them have been found to contain free sugar and Tannin. Both the leaves contain a steam volatile oily substance in small quantities (neem = 0.3 per cent, Ghora neem = 0.25 per cent) but the volatile substance present in neem leaves has got a characteristic odour.

The action of the neem leaves on some of the bacteria has been found to be positive only when the bacteria is kept in contact with either water extract or alcoholic extract taken up in water for a long time. Minimum concentration of the extract to be effective is 10 gm. of leaves per 100 c.c.

The action of neem leaves on some of the pathogenic Fungi has been found to be somewhat effective. Here also ordinary subculture method or cylinder and plate method fail and thus long time of contact is necessary.

But Ghora neem has got no action at all as has been found out by following the same procedure with Ghora neem extract.

Thus it can be concluded that neem leaves have got a very mild bactericidal and fungicidal action while Ghora neem is practically useless.

41. Some observation on the stability of Vitamin C.

K. K. ROHATGI, P. K. SANYAL and A. K. BHATTACHARJEE Calcutta.

It has been observed that vitamin C in aqueous medium deteriorates markedly in the presence of air and light. The dilute solutions deteriorate more rapidly than the concentrated ones under the same conditions. The constant stirring of the solution destroys more vitamin C. Vitamin C was found to be quite stable under the atmosphere of Nitrogen. No appreciable difference was observed on the deterioration of vitamin C, when experiments were carried out in darkness or in light of wavelength 3650A within the period of 24 hours.

Vitamin C is unstable in 10 per cent Phosphoric acid solution and deteriorates rapidly under atmospheric Oxygen, while it is quite stable under the atmosphere of Nitrogen. It has been also observed that Vitamin C in Metaphosphoric acid solution is stable under atmospheric oxygen, no deterioration was observed after keeping it for 144 hours.

The pH plays a very dominant part in the stability of Vitamin C. It has been observed that under the same conditions of experiment Vitamin C is more stable at pH 2.2 than at higher pH. At pH 4, buffered by sodium acetate and acetic acid no deterioration was observed upto 70 hours. Another very interesting point was noticed that the change of buffer mixtures influences the stability of Vitamin C. At pH 5 buffered by sodium acetate and acetic acid, no deterioration was observed till 46 hours but at pH 5.2, buffered by citric acid and Na_2HPO_4 , 6.67 per cent of Vitamin C was found to be deteriorated within 23 hours while again at pH 5.2 buffered by Potassium hydrogen Phthalate and sodium hydroxide the percentage of deterioration was found to be 16.17 per cent within 22 hours.

So, it can be said that while preparing any liquid vitamin C compound, to be used as medicine, much care and consideration are needed.

42. Action of Cashewnut shell oil in Rats.

P. K. SANYAL and M. R. CHAKRAVARTY, Calcutta.

The rats were fed with four different varieties of the shell liquid diluted with propylene glycol viz. (i) the raw oil, (ii) the distilled fraction coming out upto 255° at 7-8 mm. pressure, (iii) the distilled fraction coming out in between 235° to 255°C at 7-8 mm. pressure and (iv) the specially treated whole oil used by Dr. Bhaduri and Sanyal in the School of Tropical Medicine.

The results of the present work indicate that the raw oil as well as the distilled fractions have very much injurious effect on the heart, where haemorrhages are observed. But in the case of the raw oil the kidney and the liver remain normal, where as the 2nd fraction of the distillate (as referred to earlier) produce patchy degeneration of the tubules in the kidney. In this case the examination of the liver tissues shows much fatty infiltration of the entire lobules.

Low dose of the 1st fraction of the distillate however does not affect the heart and the liver also remains normal.

Best results were obtained with the specially treated oil prepared for the treatment of human patients. Here the heart and liver remain normal. Even with high dose, only the kidney showed some cloudy swelling of the tubular epithelium. But at low dose the kidney also remains normal.

One interesting thing to notice is that the liver in almost all the cases remain normal. Only in one case an abnormality was found and that also was not very much devastating.

This may be claimed to be a real advantage of this particular drug. On proper processing, the oil maintains its anthelmintic property accompanied by extensive decrease in the toxicity. As such its administration in proper dosage in cases of helminthiasis can be safely recommended.

43. Vitamins in Betel leaves.

P. K. SANYAL and S. SEN, Calcutta.

The object of the work was to make a comparative study of the leaves of Pan, *Piper betle* Linn. and to estimate some of the more common vitamins in some of the different varieties of the leaves usually used in Bengal, viz. Bangla or Deshipan, Mithapan and Shanchi pan.

The morphological variation of the three varieties of betel leaves were determined. The leaves were found to vary in smell, shape, colour and taste. By the size and nature of petioles the Bangla variety can be distinguished from the others.

The volatile oils were determined and were found as given in the following Table. The Misti variety is found to contain the maximum amount of volatile oil.

The vitamin contents of the different variety were determined and it was found that all the varieties there are appreciable quantities of Vitamin C (comparable to Oranges and banana). Nicotinic acid and carrotene (even comparable to carrots). The different Vitamin contents can be seen at a glance from the following table.

TABLE.

Variety	Vitamin C in mgms/100 gms.	Thiamine in γ/100 gms.	Riboflavin in γ/100 gms.	Niacin in mgm/100 gms.	Carrotene in γ/100 gms.
Bangla ..	24.3	10.5	1.9	0.893	1900
Shanchi ..	23.5	12	3.5	0.63	—
Misti ..	31.1	10	2.3	0.743	—

44. Pharmacological study of the Tincture of Rakta-Karabi (*Norium Oderum Soland*) flowers.

P. K. SANYAL, and H. K. DAS, Calcutta.

A tincture of the flowers was prepared according to the official digitalis method by drying at 50°C and percolating with 70% alcohol for 10 hours. The tincture was found by evaporation to contain 3.946% total solids. Experimenting with cats heart *in situ* this tincture was found to have a cardiotonic activity. The minimum lethal dose or LD 50 of the tincture was determined with white mice and found to be 2.1 c.c. of the tincture per kg. of body weight a sub-lethal dose of the tincture left the mice motionless, and paralytic symptoms appeared followed by signs of dyspnoea. Dissection of mice killed by a lethal dose—revealed congestion in spleen, heart and kidney and effusion in peritonian and pericardium cavity.

The active principles in the tincture were soluble in water and the fraction of the tincture insoluble in water had no activity. They were not precipitated by lead acetate. In fact the portion precipitated by lead acetate had no cardiotonic activity. The active principles could be extracted from the water solution with chloroform, which a property of cardiac glucosides, and thus served as a method of separation from saponins. In fact, glucosides were detected in the chloroform extract. Hence it seemed very probable that the active principle was a cardiac glucoside.

In large doses the drug produced a sharp fall in the blood pressure, that recovered quickly. The rate of contraction of the heart was slowed but the amplitude increased. In comparatively smaller doses the blood pressure rose steadily, the rate and the amplitude of contraction of both auricle and ventricle increased. The action of the drug was persistent. This drug should prove very effective in myocardial weakness.

45. Toxicity Determination of Several Fractions of Cashewnut Shell Liquid.

P. K. SANYAL, K. K. ROHATGI and A. B. ROY, Calcutta.

The cashewnut shell oil has been proved efficacious in the treatment of various helminthic infections like roundworm, hookworm, *Hymenolopsis nana* and *Fasciolopsis buski*. Due to the vesicant action, neither the crude cashewnut shell oil nor the distillate can be orally administered for therapeutic purpose, as both of them are toxic.

In the present work two varieties of cashewnut shell oil obtained from the seeds of Goa and Midnapore, were distilled under vacuum and the distilled portions were separated chromatographically into different fractions, in order to compare the toxicity with respect to the redistilled oil.

Seven fractions were obtained from the redistilled C.N.S.L. by chromatographic method, out of which, elute No. 2 and 3 only were in sufficient quantities to conduct the toxicity test.

As the oil has been used orally, the toxicity was determined by feeding experiments to rats. The toxicity tests showed that the redistilled cashewnut shell liquid caused damage to the hearts of the rats where haemorrhages were observed. Its injurious effects on kidney and liver were also markedly noticed. The elute No. 3 of the Midnapore variety of oil was found to be almost as toxic as redistilled C.N.S. Liquid, but perhaps its action takes place a bit slowly as can be guessed from a greater longevity of the rats fed on this fraction compared to those fed on redistilled oil. The yellowish liquid obtained as elute No. 2 from the Goa variety of oil was definitely less toxic than the above two fractions, as is clear from

both the tissue studies and also from the observation that even a dose of 0.5 cc. of the diluted fraction was not fatal to the animal.

46. The action of Chlorpromazine on the Hypothalamus.

S. R. DASGUPTA, Calcutta.

A strong central effect particularly a special affinity for the hypothalamus of chlorpromazine has been claimed by various workers, including the author.

In the present paper the available evidences of action of the drug on the hypothalamus are discussed and an attempt is made to evaluate the effect. The sifting of the evidences reveals that only four of the hypothalamic functions namely (i) 'sham rage' (ii) Pressor responses elicited by direct electrical stimulation of hypothalamic pressor areas, (iii) natural oestrus cycle in rats and (iv) thermal regulation (ability to facilitate the production of hypothermia by surface cooling) are affected by chlorpromazine.

On the other hand many other functions e.g. (1) liberation of ADH, (2) lactation and (3) lymphocytopenia of stress are not affected by the drug.

After a detailed discussion the following conclusion has been drawn: "It appears therefore, that so far as the hypothalamus is concerned, it is only the caudal hypothalamus which is sensitive to chlorpromazine, where as the anterior and possibly even the middle hypothalamus are refractory to the drug. Moreover, the sensitiveness of the caudal hypothalamus is markedly enhanced when it is freed from cortical influences".

47. Study of the effect of chlorpromazine on Lymphocytopenia of stress in rabbits and diencephalic cats.

S. R. DASGUPTA, Calcutta.

Emotional and operative stress result in a relative or even absolute lymphocytopenia. The lymphocytopenia is presumably elicited through the pituitary adrenal mechanism. Corticotrophins (ACTH) or leucocorticoids can produce lymphopenia whereas adrenaline raises the lymphocyte count even in the absence of stress. There is now general agreement that the central nervous system particularly the hypothalamus is capable of stimulating the anterior pituitary gland to secrete ACTH whenever the individual is exposed to a stressing agent. It was therefore considered that chlorpromazine might be able to prevent the lymphopenia of stress, an action which may be interpreted as an inhibition of hypothalamic activity.

Two series of experiments were performed. In the first series rabbits were used and emotional stress was applied by giving subcutaneous faradic stimulation before and after the administration of chlorpromazine. Blood (W.B.C.) count was done before and after the administration of the drug and stimulus. Leucocytosis with a relative and absolute lymphopenia resulted every time after the stimulation irrespective of premedication. In the 2nd series the excitory background of 'sham rage' was the stressing agent. Total and differential blood count was performed before and after the operation. Here again absolute lymphopenia along with marked neutrophilic leucocytosis was the result.

The findings of the present series of experiments thus show that chlorpromazine is not capable of protecting the animals from the effects of emotional or traumatic stress. This is in support of the authors earlier contention "that in its action on the hypothalamus chlorpromazine has, so far, been found to be effective on the caudal hypothalamus only".

- 48. Design of experiment suitable for routine work for assay of relative potency of human chorionic gonadotrophin utilising male toad, *Bufo melanostictus* Schneid.**

J. K. MOHANTY, Cuttack, Orissa.

The author and his associate reported "A new method of assay of human chorionic gonadotrophin utilising male toad, *Bufo melanostictus* Schneid". In that work they used 7 graded doses primarily to study the dose-response relationship, the linearity and steepness of the regression line and the suitability of the method as a whole for assaying human chorionic gonadotrophin. Further studies showed that for routine assays of relative potency only a 6-point assay (3 doses of the unknown and 3 doses of the reference standard preparation) is necessary. The present paper gives the details of statistical design and performance of the 6-point assay suitable for routine work.

- 48(a). Studies on seasonal variation in the reactivity of male toads, *Bufo melanostictus* Schneid in the assay of human chorionic gonadotrophin.**

J. K. MOHANTY, Cuttack, Orissa.

The author and his associate worked out and reported, "A new method of assay of human chorionic gonadotrophin utilising male toad, *Bufo melanostictus* Schneid" as the test animal. But no evidence was provided if the seasonal variation would affect the results of assay. The present report embodies the results of study on this point.

Bi-monthly assays were performed for a whole year using the same unknown and standard preparations of human chorionic gonadotrophin stored under standard conditions. Statistical analysis of results showed that the reactivity of toads varies to some extent in the different seasons in that there is slight shift in the MED but there is no significant change in the slope of the regression lines, all being parallel. The conclusion is that slight seasonal variation in the reactivity of the test animals does not affect the accuracy of the assay, provided that in each assay a reference standard preparation is used for comparison.

- 49. The site and mechanism of development of tolerance to hexamethonium.**

J. K. MOHANTY, Cuttack, Orissa.

The author reported that tolerance to ganglion blocking action of hexamethonium and related substances follows their administration to intact animals and that in the blood of hexamethonium treated animals and patients an unknown substance is present which confers on the ganglia tolerance to the drug and its chemical relatives.

The present studies to find out the site and mechanism of development of tolerance were made on superior cervical ganglion—necrotising membrane preparations of cats with (i) evisceration, (ii) evisceration and total nephrectomy, (iii) total nephrectomy, (iv) evisceration with subsequent incorporation of isolated liver into the circulation. Experiments on closed circuit perfusion of isolated livers, and cross-circulation between normal and hexamethonium treated eviscerated animals were also made.

The results of experiments provide evidence that liver is the site of development of tolerance. It also inactivates a substantial part of a given dose of hexamethonium. The substance conferring tolerance on the ganglia to hexamethonium is formed in the liver and is carried through blood. It might be a conjugated

or degraded product of hexamethonium. Kidney does not play any role in the development of tolerance but is concerned only with the excretion of the drug.

50. Nickel-ammine formation in Aqueous solution.

P. C. SINHA and R. N. MUKHERJEE, Patna.

The complex formation between nickel sulphate and ammonia has been studied thermometrically by the method of Dutoit. The method was modified to eliminate its defects. The values of difference in heat contents of the system was plotted against the volume of titrant. The breaks in the graph corresponded with the formation of diamino-, triamino-, tetramino-, and hexamino-, nickel ions in solution.

51. A study of halteres of sandflies.

R. D. MITRA, Poona.

The halteres of specimens of *P. argentipes*, the Indian vector of Kala-azar and *P. papatasii*, the vector of sandfly fever were studied to ascertain if a co-relation exists between the altitude of the place and size of halteres of sandflies found in that place. Some specimens of these species obtained from Poona (altitude 2100'), Panchgani (altitude 4378') and Jammu and Kashmir valleys (average altitude 5500') were examined for this purpose.

It was found that the halteres of specimens of these species found at a higher altitude are narrower and more lanceolate in shape than the halteres of these insects found in the plains.

52. Role of albuminoid ammonia and other chemical factors in the breeding of anopheles sundaicus (Rodenw): A preliminary note.

PURNENDU SEN, Calcutta.

Water sources around the city of Calcutta were examined to find out if the chemical constituents of the water were responsible for the breeding of *Anopheles sundaicus* which is a virulent transmitter of malaria in lower Bengal.

PH, Alkalinity, Chlorides, Albuminoid ammonia, Free ammonia, Absorbed oxygen, Nitrites, Nitrates, Carbonates, Fe, Ca, Mg, and suspended matters were analysed in relation to the breeding of the particular species.

It was found that chloride content of the water regularly increased during the breeding of the species which happen to be salt water breeder.

The data for albuminoid ammonia on statistical analysis showed a definite correlation with the breeding of the species. Actually the breeding takes place when this factor is low compared to the figures obtained at other times when there was no breeding.

Free ammonia increased slightly with the reduction of albuminoid ammonia. As regards the other constituents studied no apparent correlation was noticed.

VETERINARY SECTION

53. Some Observations on Johne's Diseases in Sheep.

P. G. PANDE and D. KRISHNA MURTY, Mathura.

With the control of Tuberculosis in most of the European countries, the problem of combating infection of Myco-johneii came into prominence during the

recent years. Although this disease entity has been recognised almost along with Tuberculosis, yet it has not been subjected to such intensive studies mainly due to its lack of significance to public health. But from the point of view of animal husbandry, it is perhaps more devastating in its effects on animal health and in view of the chronic insidious nature of this disease, long and irregular period of incubation, absence of any definite clinical symptoms, and lack of suitable diagnostic methods to detect preclinical state of infection, control of this disease is still a complex problem facing the veterinarians.

In India, this disease was introduced into some of the organised herds along with the foreign breeds and has spread to those areas where these farm-bred animals were distributed. In sheep this disease was first detected in this country at Hissar and except for stray reports of its incidence in a few other flocks, no systematic studies appear to have been conducted in this country so far on this disease.

In this paper it is therefore proposed to describe an investigation conducted on some aspects of Johne's disease in a flock of sheep maintained at the District Dairy Demonstration Farm, Mathura during the past two years. Although by the nature of soil and climate, this farm is considered to be not very suitable for Paratuberculosis to flourish, yet during the period of investigation over 20% of the flock succumbed to this disease and actual financial loss due to this mortality alone worked up to over Rs. 2,000/- for a small flock of about 200 animals in spite of heavy culling during the period.

All the animals were subjected twice to allergic tests and concentrated synthetic Johnin was used by single intradermal method at the caudal region. 57.1% of the flock gave positive reaction during the first test. It was observed that over 25% of the lambs below six months of age gave positive reaction and their percentage did not alter appreciably, even after culling all positive reactors, during the second test. Some of these young animals showed clinical symptoms and lesions of this disease. Over 41% of the animals which died due to this disease during this period, gave negative reaction to the allergic test, when alive. Smears from bowel washings and pellets were examined from all the sheep. Although there is a considerable correlation between these two microscopic methods, yet only 20% of the affected sheep gave positive result by these methods which were mainly useful to detect cases in advanced stage of the disease by which time usual clinical symptoms appeared. Several of these animals gave negative reaction to Johnin test, indicating the loss of sensitivity of the tissues to johnin at this stage. Limitations of these tests for diagnostic purposes have been pointed out.

From the few cultural studies made, the disease in this flock appears to be due to a nonchromogenic strain of *Myco. johnei*. Autopsies were conducted on 67 cadavers of sheep which died during this period and 59.7% of these animals showed the lesions of this disease. Four types of intestinal lesions were encountered in those animals. Except in five cases, characteristic diffuse thickening of the intestinal wall with transverse corrugations of the mucosa, described as a constant feature of this disease in cattle, was not observed in these animals. In the most common type, of intestinal lesions encountered, there was no appreciable thickening of the mucosa, but the mucous membrane was coated with greyish, thick, pasty material with streaks of congestion. Two cases of ulceration of mucosa and two cases of localised nodular formation were also encountered due to this disease.

54. Two Cases of Amyloidosis in Domestic Animals.

R. M. KALAPESI and B. L. PUROHIT, Bombay

In man, amyloidosis may occur in chronic suppurative processes, chronic destructive infections and wasting diseases. Although domestic animals have

similar diseases, this condition does not appear to be as common in them as is reported in man. It is reported to have been encountered more in horses used for the production of antitoxic sera, than those suffering from chronic wasting diseases and suppurative processes. This has not, however, been confirmed by an institution in Bombay which maintains horses for manufacture of antitoxic sera. In dogs, it is reported to be extremely rare. Though many cases have been reported in the European continental literature, references to naturally occurring amyloidosis in English veterinary literature are extremely scarce. From India, there are absolutely no records of amyloidosis in domestic animals, in the available literature.

It is, therefore, interesting to record two cases of amyloidosis, one in a cow, associated with an emaciating disease and presence of small chronic abscesses in liver and the other in an Alsatian female dog, associated with Tuberculosis. Histopathology of the affected liver, spleen and kidney has been described, and photo-micrographs taken.

55. A New Species of *Eimeria* from a cow-calf in Bombay State.

L. S. HIREGAUDAR, Bombay.

A new species of coccidia under the name of *Eimeria mundaragi* from a cow-calf is described from Bombay. *E. mundaragi* resembles *E. wyomingensis* and *E. bombayensis* but differs from the former in having the wall of the oocyst pale yellow or yellow instead of yellowish or greenish brown and the sporulation time 24-48 hours instead of 120-168; and from the latter in possessing an egg-shaped oocyst instead of ellipsoidal or cylindrical and with a more distinct micropyle.

56. Some Observations on the Bionomics of *Indoplanorbis Exustus* Desm. (Gastropoda).

J. B. KATHURIA, DR. S. R. RAO and L. S. HIREGAUDAR, Bombay.

The common fresh-water snail, *Indoplanorbis exustus* is an intermediate host of many trematodes affecting domestic animals. The study of the bionomics of *I. exustus* has been attempted, as it would help, in devising preventive measures by changing natural conditions, in such a way as to render them unfavourable for their continued existence. These snails can be easily bred in an aquarium set up in a simple manner. A pure laboratory bred snail begins to lay egg-masses when 6-8 weeks old and continues to lay for about 45 days. The number of egg-masses laid by an individual during life varies between 25-40 and the total number of egg-capsules and eggs between 400-600. The development of the egg passes through trochosphere and veliger stages in 48 hours and the young snail comes out of the egg-capsule in 6-8 days, depending upon the environmental conditions. Roughly the growth of 1 m.m. per week has been calculated from the observations made on the growth of the young snails after their emergence till they were 10 weeks old. The life of *I. exustus* under laboratory conditions is from 3-5 months. The adult snails can survive for a long time provided the water in which they are maintained is changed every alternate days. The snails in test tubes survive from 25-35 days.

An investigation into the cercarial fauna of Bombay State for the last three years shows that 5-10% of *I. exustus* snails are infected with fercocercus, diastome and amphistome cercaria.

57. Determination of the Electrical Axis of the Heart in Goats of Jamnapuri Breed.

DEBABRATA ROY CHOWDHURY and D. P. SADHU, Calcutta.

Electrocardiogram was recorded in healthy goats of Jamnapuri breed. Electrodes were attached on all the four legs, the potential difference between left and right fore legs being designated as Lead I, that between right fore leg and left hind leg as Lead II and that between left hind leg and left fore leg as Lead III. Right fore leg was connected with an electrode as a ground connection, as demanded by the instrument (Viso-Cardite). Usually the first and second leads are inverted and the third lead erect, although P and T waves are erect in all the leads.

58. Effect of Lucern on the Isolated Rat Uterus.

BHUPEN CHAUDHURI and D. P. SADHU, Calcutta.

Lucern is a bloat-provoking pasture. It shows inhibitory effect on the motility and tone of intestinal movements. The effect of lucern has been studied on the plain muscle of uterus. Crude juice of lucern stimulates uterine movements in 5×10^{-3} to 2.5×10^{-2} concentration, but in higher concentration of 3.35×10^{-2} concentration it inhibits the rhythmic contractions and tone of uterine musculature. Aqueous extract or acid extract of lucern is inhibitory to uterine contraction in 7×10^{-3} concentration, aqueous extract being more potent than the acid extract. These have no stimulatory effects on the uterine contraction.

59. Vitamin A Deficiency in Lambs.

N. D. KEHAR, P. C. SAWHNEY and A. N. BAHL, Izatnagar.

Two groups of sheep kept on a maintenance ration were selected for the experiment. One of the groups was given a restricted supply of green *i.e.*, 1 lb. green twice weekly while the other received 1 lb. green daily. The former group, however, received no green during last 60 days of gestation and the first 60 days of lactation.

The performance of sheep in the two groups showed a considerable difference as regards birth weight of lambs, their growth rate, weaning weight and mortality. The birth weight of lambs of the former group (sub-adequate supply of green) ranged from 2 lb. 8 oz. to 4 lb. 12 oz. with an average of 4 lb. 1 oz. while those from the latter groups (adequate supply of green) ranged from 5 lb. to 5 lb. 12 oz. (average 5 lb. 5 oz.). The average rate of growth in the lambs of the former group was 7.6 oz. to 14.0 oz. (average 11.67 oz.) per week while for the latter group the rate was 11.2 to 23.45 oz. per week (average 16.3 oz.). The mortality in the former group was more and that too at an early age. The post mortem examination revealed deaths mostly due to pneumonia.

Part II. Growth rate of lambs and the influence of feeding vitamin A sub-adequate diet to lambs on their growth rate and clinical symptoms of the deficiency.

The lambs born of dams on sub-adequate supply of green were used for studying the vitamin A deficiency symptoms while these from dams on adequate supply of greens were used as control.

Both the groups of lambs received a concentrate mixture. Wheat straw exposed to sun was given *ad lib.* The control group received green in addition.

The animals of the two groups continued to grow up to 24 weeks at almost equal rate. After this there was a decline in the growth rate of vitamin A deficient lambs. During the subsequent 28 weeks the average gain in live weight in vitamin A deficient group was 3 lb. 11 oz., rate of growth being on the average 2.1 oz. per week while the average gain in live weight in the control group was 25 lb. 2 oz. and the average of growth rate is 14.36 oz. per week.

There was no significant difference in the dry matter consumption in the two groups.

Symptoms.—The earliest symptoms were night blindness and incoordinated gait accompanied by muscular weakness. The animals showed stunted, emaciated and dejected appearance and exhibited nervous weakness. The eyes were dull and lustreless. Some of the animals developed heteropia which later developed into xerophthalmia followed by opacity of cornea. The respiration in the deficient animals was markedly hurried and the body temperature was throughout normal. The hooves were deformed. There was a marked atrophy of the testis in the deficiency group which showed marked decrease in the sexual desire. Vitamin A deficiency had a marked effect on wool growth—the control group giving about 2.8 times greater wool growth as compared to the deficient lambs.

The weight of the testis of the control lambs was about 7 to 10 times more than the weight of testis of the deficient lambs.

A large amount of fat deposits was found in the control lambs while practically little fat deposition was noticed in the deficient lambs.

The livers of the vitamin A deficient lambs had about 2.344 $\mu\text{g}/\text{gm.}$ to 3.14 $\mu\text{gm}/\text{gm.}$ of vitamin A while the livers of the control group lamb had 70.3 $\mu\text{gm.}/\text{gm.}$

On post mortem examination the lambs of the deficient group had pale and friable livers. Kidney capsule could be easily peeled off and medulla was pale and anaemia. Rumen, reticulum and omasum were normal. Abomasum showed distinct whitish circumscribed and elevated areas over the mucous membrane. Small intestines were congested. Testis were atrophied and the testicular parenchyma had very perched area which was not vascular. Bladder was normal but was thrown into folds. No urinary calculi were observed.

60. Blood Constituents in Relation to Vitamin A Deficiency.

N. D. KEHAR, P. C. SAWHNEY and A. N. BAHL, Izatnagar, U.P.

The blood of lambs on vitamin A deficient diet was examined every month and compared to that of the control group of lambs.

The values of various blood constituents in the deficient lambs did not vary significantly from the corresponding values in the control group upto 8 months of experimental feeding after which there was a gradual change.

The average values for the various constituents in 10th, 11th, 12th, and 13th months of feeding were as below :—

1. Red blood cells :—10.49, 9.42, 9.09 and 7.26 millions per cmm. in the deficient group as compared to 10.45, 11.13, 12.56 and 12.37 millions per cmm. in the control group.
2. Total leucocyte count :—14.54, 15.45, 16.09 and 19.81 thousand per cmm. in control group.
3. Differential count :—There was a rise of about 13 per cent in polymorphs in case of deficient lambs compared to control group while the lymphocytes were lowered.

4. Haemoglobin :—9.19, 8.42, 8.77 and 8.86 gms. per cent in the deficient group as compared to 11.49, 11.79 and 11.41 gms. per 100 ml. in control group.
5. Cell volume :—29.2, 25.8, 27.0, 23.4 per cent in deficient group as compared to 33.3, 35.5, 37.5 and 35.5 per cent in the control group.

The differences were found to be highly significant as the deficiency progressed.

61. Vitamin A Deficiency and Urinary Calculi in Goats.

B. DUTT, B. N. MAJUMDAR and N. D. KEHAR, Izatnagar, U.P.

At present there is divergence of opinion regarding the aetiological factors responsible for formation of urinary calculi in men and animals. Some workers suggest vitamin A deficiency as being responsible for formation of urinary calculi whereas other oppose it. Again some workers are of the opinion that hard water, mineral imbalance and urine reaction are responsible for formation of urinary calculi. The present article is an attempt to adduce evidence to show that vitamin A deficiency is probably the chief factor responsible for formation of urinary calculi in goats.

Adult male goat of 2-3 years age were kept on carotene free diet for about one year and eight months. Corneal ulceration, unthrifty condition, night blindness, elongated hooves and falling of hairs in patches were the characteristic clinical symptoms.

Histo-pathological examination of kidneys revealed interesting changes. There was wide spread keratinisation of renal epithelium; cytoplasm of most of the cells was shed with the result that most of the cells looked smaller. The shed cytoplasm had assumed granular, reticular or homogenous hyaline appearance due to the precipitation of albuminous material during fixation. Some of the tubules contained granules and which had taken up the haemotoxylin stain, are suggestive of the deposition of calcium salts. Obviously, these granules are the remains of the shed and degenerative epithelial cells. The walls of the intertubular blood vessels also showed hyaline degenerative changes and portions of the walls of such vessels showed deposition of calcium salts. It seems that such degenerative changes as seen in kidneys are the precursors of formation of urinary calculi. Further confirmation of the above findings will be obtained when the next batch of goats are autopsied.

62. Histopathological Studies on the Tissues of Rats Fed on Raw Milled Rice and Raw Milled Rice and Tapioca.

BRAHM DUTT, Izatnagar, U.P.

Degenerative changes in the intestines of rats kept on raw milled rice for seven months have been recorded. The mucous membrane of the small intestines of rats showed coagulative necrotic changes. Inflammatory changes were not observed either in the mucous or sub-mucous membrane.

In the rice and tapioca group rats, liver showed marked degenerative changes. Liver cells had the characteristic appearance of foam cells. Protoplasm of some of the non-vacuolated liver cells was studded with deeply eosinophilic granules indicating further degenerative changes of liver cells.

63. Effect of Partial Replacement of Rice or Wheat by Tapioca and Sweet Potato Flours in poor South Indian Vegetarian Diets.

B. N. MAJUMDAR, D. C. SHARMA and N. D. KEHAR, Izatnagar, U.P.

A comprehensive study on rats to determine the effect of substitution of rice or wheat with tapioca and sweet potato flours during different seasons has been made. The following conclusions have been drawn :—

1. Season appears to have a great influence on rat growth. In winter months the average growth rates of rats in all the comparable groups were very much higher, while in summer their growth rates were lowered.

2. Substitution of a rice diet with tapioca flour to the extent of 25 per cent improves the diet as shown by an increased gain in weight by the rats both in winter and summer.

3. When a wheat diet is thus substituted its supplementary feeding value is dependent upon the season; in summer the effect was nil or even worse while in winter the growth appeared to be slightly better.

4. Sweet potato flour, when it forms the substitution instead of tapioca flour leads to an impairment of the nutritional value of the basal diet in either summer or winter.

5. The results of statistical analysis of the data have been presented.

64. Lentil (*Lens Esculenta*) Bran as Cattle Feed.

R. S. SINHA and K. SAHAI, Izatnagar, U.P.

Lentil (*Lens esculenta*) is one of the most ancient leguminous seeds and is commonly used as vegetable soup in western countries. Lentil, in one form or other, has long been known for its high feeding value to live stock in general and cattle in particular.

Lentil bran or *masoor chuni* on chemical analysis was found to contain on dry basis crude protein 20.5%; ether extract 3.2%; total carbohydrates 71.7%; calcium (CaO), 0.43 phosphorus (P_2O_5), 0.79 per cent.

To study the nutritive value of the bran, six Kumaoni bullocks were fed on lentil bran and wheat *bhoosa*. The digestibility of crude protein, ether extract and total carbohydrates in the bran, calculated by the method of elimination, was found to be 62, 70 and 52 respectively. The digestible crude protein and total digestible nutrients in lb. per 100 lb. of dry bran were found to be 12.7 and 55.0 respectively.

The animals presented positive balances in respect of nitrogen, calcium and phosphorus and maintained good health throughout the feeding period.

The lentil bran, in digestible crude protein value is comparable to pulses like gram and *arhar* and is superior to wheat bran, and on the basis of these experiments it may be concluded that *masoor chuni* may be used to replace the usual concentrate feeds in the ration of cattle.

65. Tannin content of some leafy fodders and its distribution in different tree leaves.

M. N. D. GOSWAMI and N. D. KEHAR, Izatnagar, U.P.

In an investigation carried out in this laboratory as to the possible role of tannins affecting the utilisation of proteins by animals, the tannic acid content was estimated in a number of edible tree leaves and leafy fodders. The samples were analysed either as green or in a powdered form after drying at a temperature below 100°C. The tannic acid contents varied greatly in different leaves, ranging

from zero to as high as above 10%. The following leaves and seeds were found to be particularly rich in the tannic acid viz.,

				In terms of gallo-tannic acid (% dry basis)
<i>Leaves.</i>				
Rohini leaves (<i>Mallotus philippinensis</i>)	...	...	...	13.18
Bankli (<i>Anogeissus latifolia</i>)	...	...	...	11.90
Kumbhi (<i>Carea arborea</i>)	...	...	...	11.25
Bahera (<i>Terminalia balerica</i>)	...	...	...	8.81
Tenda (<i>Diospyros tomentosa</i>)	...	...	...	8.56
Sein (<i>Terminalia tomentosa</i>)	...	...	...	7.81
Gajinia (<i>Saurauja napaulensis</i>)	...	...	...	6.53
Sal (<i>Shorea robusta</i>)	...	...	...	6.30
Kusum (<i>Schleichera trijuga</i>)	...	...	...	5.09
Khair (<i>Acacia catechu</i>)	...	...	...	4.66
Phaldu (<i>Mitragyna parbiflora</i>)	...	...	...	2.10
Mango (<i>Mangifera indica</i>)	...	...	...	1.86
Neem (<i>Azadirachta indica</i>)	...	...	...	1.61
<i>Seeds.</i>				
Mango seed	...	...	...	2.80
Jaman seed	...	...	...	3.03

A study of the seasonal variation of the tannic acid content in a few commonly fed leaves showed that tannic acid was negligible in *Kathal* leaves (*Anteearpus integrifolia*) and practically nil in *pipal* leaves (*Ficus religiosa*). *Jaman* (*Eugenia jambolana*) leaves showed the maximum content particularly in the months of May and June rising as high as 20%, whereas *Pakar* (*Ficus infectoria*) leaves showed a considerable amount particularly in the months of July to September, when it ranged from approximately 4% to as high as 7% on dry basis.

66. Nutritive value of tannin rich fodder with reference to protein metabolism.

M. N. D. GOSWAMI and N. D. KEHAR, Izatnagar.

Chemical analyses of a large number of different feeding stuffs showed that many tree-leaves, but by no means all, are rich in tannic acid content. To study the effect of the presence of these organic acids in the feed, an investigation was conducted. Metabolism trial of *Pakar* (*Ficus infectoria*) leaves (4.5% tannic acid content) on adult Kumauni bullocks showed that the apparent crude protein digestibility was only 27.7% as against an expected figure of 50-60%. When, however, *Jaman* leaves (*Eugenia jambolana* 8.9% of tannic acid) were fed to three adult bullocks, the consumption which was satisfactory at the beginning gradually fell down and in one animal where the consumption was somewhat satisfactory, negative protein digestibility was recorded. When oil cake was incorporated in the ration, the consumption was satisfactory but the combined crude-protein digestibility was only 21% as against the expected digestibility of about 50%. The protein digestibility of *pipal* leaves (*Ficus religiosa*, tannic acid content nil) was found to be normal, both when fed as single feed as well as when supplemented with oil-cake.

This depressing effect of the presence of tannic acid could be imitated to a certain extent both in case of bullocks and goats. When with a control ration of wheat bhoosa and linseed cake, gallo. tannic acid (BDH) to the extent of 5% of the ration was fed, the crude protein digestibility was significantly depressed from 43.2 ± 1.1 in the control group to 22.6 ± 3.0 in the tannic acid group. An inclusion of approximately 2% acid in the ration of adult goats consisting of *pipal* leaves and

oil-cakes, lowered the digestibility coefficient of protein from 56.0 ± 0.50 in the control group to 51.6 ± 0.24 in the tannic acid group.

It was also noticed that in a combined ration of tannic acid containing roughage and cake protein, the digestibility coefficient of cake-protein was lowered. This was, however, not the case when *pipal* leaves (tannic acid content nil) were fed along with the cakes, as is shown in the table below :—

No.	Name		Digestibility of cake-protein found (%)	Depression in % assuming cake- protein as 90% digested
1.	<i>Pipal</i> (bullock)	...	96.7	nil
2.	<i>Pakar</i> („)	...	54.1	36.3
3.	<i>Jaman</i> („)	...	38.3	57.4
4.*	<i>Pakar</i> (Goat)	...	51.6	42.6

This shows that in a tannic acid containing diet, the protein requirements of the animals will be higher than the calculated standard figures.

67. Virginian Tobacco seed Cake as a protein substitute for Cattle.

N. D. KEHAR and B. C. JOSHI, Izatnagar, U.P.

Virginian Tobacco seed cake is a product of the tobacco industry and most of it finds its use as a manure, at present. Attempts were made whether it could be utilised for feeding cattle. On chemical analysis Tobacco seed cake was found to have the following percentage composition on dry matter basis :—Crude protein 29.95, ether extract 10.37, crude fibre 22.23, nitrogen free extract 24.66, total carbohydrates 46.99, total ash 12.69, calcium (Cao) 0.79 and phosphorus (P_2O_5) 1.74.

To determine the nutritive value of the cake feeding experiments were conducted on four kumaoni bullocks. Tobacco seed cake was introduced gradually into the concentrate moiety of the animals in such a way that in about a fortnight the whole concentrate quota was replaced by Tobacco seed cake. Wheat bhoosa was fed as the sole roughage. After a preliminary feeding period of about seven weeks a metabolism trial was conducted on the animals. The animals showed on an average positive balances with respect to Nitrogen, Calcium and Phosphorus. Throughout the feeding period the animals maintained good health and no adverse symptoms were observed.

The average digestion coefficients for crude protein, ether extract and total carbohydrates were found to be 88, 100 and 42 respectively. The digestible crude protein, total digestible nutrients and starch equivalent in lb. per 100 lb. of the cake on dry matter basis were 26.33, 69.37 and 56.5 respectively.

From the above observations it will be seen that with regard to digestible crude protein Tobacco seed cake compared favourably with common oil cakes like coconut or cottonseed though in energy value it is somewhat poorer.

68. Studies on the properties of the factor in Lucern affecting intestinal movements in the ruminants.

A. CHATTERJEE, S. B. CHOWDHURY and D. P. SADHU, Calcutta.

The results embodied in this paper is in connection with the isolation of the factor in pasture that affects the movements of the isolated intestines. The fresh

* Ground nut cake used in this case, in others linseed cake.

juice prepared from Lucern inhibited the movements of the isolated intestines in very low concentrations. Portion of the same juice was then heated to 60°C to precipitate the Chlorophyll and the juice was filtered to separate the Chlorophyll portion. The clear brown filtrate thus obtained, when added to the intestines, failed to produce the effect of the crude juice even in much higher concentrations. The residue on the filter paper was then taken in a Waring blender, mixed with Ringer's solution and distilled water and was thoroughly blended. This suspension when added to the isolated intestines failed to produce the desired effect even at comparatively large doses.

Weighed samples of green Lucern were then air-dried and ashed in a Muffler's furnace. The ash was dissolved in Distilled water and weak solutions of alkali respectively and added to the isolated intestines. Here again, the desired effect could not be demonstrated.

Samples of green Lucern were then extracted with different solvents. It was found that the water extract for 12 hours, 24 hours and 36 hours, all inhibited the movements of the isolated intestines even in concentrations of 0.25—0.50 c.c. in 120 c.c. of the Dale's bath of Ringer's solution. The water extract, when evaporated and the residue redissolved in distilled water failed to produce the desired effect. The water extract was then desalted for 3-4 hours and the desalted extract again inhibited the movements in equivalent doses of the original water extract. Further extraction of the solution Chloroform and Aether had no effect.

From the results obtained it was evident that the factor was highly soluble and was thermolabile. Further studies are in progress.

69. The effect of Crude Lucern Juice on the Isolated intestines.

A. CHATTERJEE, S. B. CHOWDHURY and D. P. SADHU, Calcutta.

Part I.—Preliminary studies.

During the course of studies on the pathogenesis of Bloat, it was decided to study the effect produced by the crude juice of Lucern, cut during the season for Bloat, as Lucern had been classified as one of the typical Bloat provoking pastures by the recent investigators. Fresh samples of the grass were cut to pieces, minced in a mincer and the juice was expressed out. The effect of the juice on the isolated intestines of goats were studied in a Dale's Isolated Organ apparatus. It was observed that the crude juice had a strong inhibitory effect on the intestinal movements in a dose as small as 2 c.c. while in a concentration of 5 c.c. in 120 c.c. of the Ringer's bath, the movements were completely arrested.

Part II.—The effect of the crude juice of Lucern at different stages of growth of the grass.

Under the present investigations it has been observed that Lucern, a Bloat provoking pasture, is not always inhibitory to the movements of the isolated intestines during different stages of growth of the grass. During the primary stage of growth, crude juice prepared from the samples inhibited the movements of the isolated intestine of goats in doses from 2.5 c.c. when added to 120 c.c. of the bath. During the intermediate stage of growth of the grass, the crude juice failed to produce the effects even in as large a dose as 15 c.c. On the contrary, during the flowering stage of growth of the grass, the crude juice prepared from the grass including the flowers and seeds, from the flowers and seeds and from the leaves and stem all produced marked stimulation in doses varying from 2.5 c.c. The samples were collected from the same plot during the whole series of experiments and the results were recorded in a Dale's Isolated Organ Apparatus.

70. The Seasonal Variation in some of the Mineral Components of Lucern.

S. B. CHOWDHURY, A. CHATTERJEE and D. P. SADHU, Calcutta

Under the present series of experiments, the changes in some of the important inorganic salts in Lucerne according to the changes of growth of the grass, have been studied. It has been observed that particularly the Magnesium and Calcium contents vary considerably according to the change in season or the growth of Lucern. According to the percentages estimated in our laboratory, solutions were prepared in distilled water and the effects studied on isolated intestines in a Dale's Isolated Organ Apparatus. The effects could not be correlated with that obtained with the crude juice of the same samples.

71. The effect of Crude Juice of Gunea Grass on the isolated intestine.

D. P. SADHU, A. CHATTERJEE and S. B. CHOWDHURY, Calcutta.

In this present investigation, the action of crude juice of Gunea grass on the isolated intestines of the ruminants was studied. Samples of Gunea grass were collected, cut to small pieces and minced in an electric mincer. The juice thus obtained was filtered through muslin. Portions of intestine of freshly slaughtered goats were connected with the Dale's Isolated Organ Apparatus and suspended in 120 c.c. of Ringer's solution. The temperature of the water bath was controlled at 39°C. The juice was then added to the suspended intestine and the effects were recorded on a drum moving at a speed of 0.1 m.m. per second. It was observed that the crude juice stimulated the movements of the intestine at doses from 1 c.c. to 4 c.c. according to samples and plots from which the samples were collected. The stimulation was most marked with certain samples.

72. The effect produced by a combination of Lucern and Gunea Grass Juices on the isolated intestines.

S. B. CHOWDHURY, A. CHATTERJEE and D. P. SADHU, Calcutta.

In course of the studies on the effect of Lucerne and Gunea grass crude juices on the isolated intestines of ruminants, it was observed that while crude juice of Lucern inhibited the movements, that of the Gunea grass stimulated the movements. Subsequently, mixtures of the two juices were prepared in different concentrations and it was observed that in a combination as small as 0.5 c.c. of the Gunea and 5.0 c.c. of Lucern, the movements were stimulated considerably and the inhibitory effects of Lucerne were completely superseded.

From the results of different sets of combinations, it was concluded that a small quantity of Gunea grass in combination with Lucern can completely counteract the inhibitory effects of the latter and can minimise the risks of Tympanitis in threatened areas and pastures.

73. The Isolation of the active principle in Lucern affecting intestinal movements.

A. CHATTERJEE, S. B. CHOWDHURY and D. P. SADHU, Calcutta.

Bloat is a gaseous distension of the rumen in ruminant animals produced by certain green grasses, Lucern being one of them. An attempt was made to isolate the bloat provoking principle present in Lucern and the effects produced by the fractions were studied on isolated intestines of freshly killed goats in a

Dale's apparatus at a temperature of 38°C, which is the normal intraruminal temperature of goats.

Samples of green Lucern were extracted with alcohol for 48 hours and the extract was evaporated completely. The residue when dissolved in distilled water, inhibited the movements of the isolated intestines. Alcoholic extract of subsequent samples were evaporated for 15-20 minutes when a crop of rhombic crystals separated which were insoluble in water and were biologically inactive. This was centrifuged out and the supernatant again allowed to evaporate for further 15-20 minutes when a second flock of needle shaped crystals separated. This was centrifuged out and in solution in distilled water stimulated the intestinal movements. The supernatant, which gave no more crystal were allowed to evaporate. An oily residue was obtained which was highly hygroscopic. This residue, when dissolved in distilled water and added to the isolated intestines inhibited the movements. This inhibitory fraction was a specific protein.

74. Glycogen Synthesis in the Ruminants.

S. B. CHOWDHURY, A. CHATTERJEE and S. B. CHOWDHURY.

The normal Rumensflora of goats, with special reference to those associated with the synthesis of Glycogen have been studied. The Rumen material were collected from goats immediately after they were slaughtered in the abattoirs. The technique adopted by Qin et al. of the Oenderstport laboratory were followed throughout the experiment. Certain pseudoyeast cells were recovered, from the ruminal Fluid which were demonstrated to ferment Glucose at a much rapid rate and transform the Glucose to Glycogen inside their body. After synthesis of Glycogen, these cells gave positive reaction to Gram's Iodine and fine granules of Glycogen were demonstrated under a microscope. These pseudoyeast cells were morphologically identical with the *Schizosaccharomyces Ovis* described by other workers in the Rumen of sheep. The authors have suggested to change the nomenclature of the species and to name these cells as *Schizosaccharomyces ruminatum*, instead of naming them according to the hosts from which they are recovered.

75. The efficacy of sulphadrugs and antibiotics in 'Foot Rot'-infections in Cattle.

A. CHATTERJEE and C. R. BISWAS, Calcutta.

Part—I. *The relative activity of Sodium Sulphapyridine and Sodium Sulphamezathine.*

Tests were carried out to study the relative activity of Sodium Sulphapyridine and Sodium Sulphamezathine against artificially produced as well as active cases of Foot Rot infections in cattle. The first batch of animals received Sodium Sulphapyridine in doses of 60 gms dissolved in 500 c.c. of distilled water according to Dr. Forman's technique. The second batch received Sodium Sulphamezathine, 33.1% in doses from 50-60 c.c. intramuscularly. Equal number of controls were maintained. The single injection specificity of the drugs were then compared. It was observed that with Sodium Sulphamezathine the results were relatively better and the time required in days to subside the swelling, lameness and for the completely recovery was less and the percentage of recovery was high.

Part—II. *The relative activity of the topical application of Penicillin, Streptomycin, Aureomycin and Chloromycetin.*

Tests were carried out to study the relative activity of the topical application of the above mentioned antibiotics against artificially produced as well as active

cases of Foot Rot in cattle. 1%, 2.5%, 5%, 7.5% and 10% solutions of the antibiotics were prepared by dissolving them in normal saline. One foot of each animal was treated while the other was left as control. The solutions were painted topically with the help of small paint brushes. The cases were observed after a single application. It was found that with the 1% solution, all the cases relapsed although the relapses were delayed with Aureomycin and Chloromycetin. The best results were obtained with the 7.5% and 10% solutions of Aureomycin and Chloromycetin and the recovery was as high as 100%. From the observations on the time required to subside the different symptoms it was found that with the 10% solution of Chloromycetin, the recovery was more rapid. The cases were observed for 30 days and there was no relapse.

76. The Heart and Coronary blood vessels of the Indian Elephant.

M. D. RAJAGOPAL, Madras.

The heart and the coronary vessels, are described in seven specimens (3 Foetal, 1 Young and 3 Adult of the Indian Elephant. (*Elephas indicus bengalensis*).

The apex of the heart is bifid due to the depth of the *incisura cordis* and the separation of the apices of the two ventricles in all the specimens; however the apex of the left ventricle extends more caudally.

The number of pulmonary veins opening into the left atrium is 1 in one specimen, 2 in five specimens and 4 in one specimen.

Pale yellow subepicardial fat is present in the inter-ventricular and coronary sulci.

The aorta has three semilunar cusps (dorsal, right and left ventral) and the pulmonary artery has also three (ventral, right and left dorsal).

Two coronary arteries are present, arising from the right and left ventral aortic sinuses, in all the specimens. An additional artery arises from the right ventral sinus in one foetal specimen.

The arterial supply to the atria does not follow any generalised pattern, either regarding source or distribution. In one specimen an extra large atrial artery arises from the trunk of the left coronary. In others the atrial arteries are small and originate from the circumflex branch of left coronary, and the right coronary artery.

Precapillary anastomosis of terminal branches of coronary arteries and communications between the smaller distal radicals of the veins are present.

The great cardiac vein opens into the right atrium in two specimens, and to the left precaval vein in five. The middle cardiac vein opens into the left precaval vein in three, into the great cardiac vein in two and into the right atrium in two specimens. The right cardiac vein opens into the right atrium in five, into middle cardiac vein in one and into the left precaval vein in one specimen.

77. Haemoglobin status of farm animals in different parts of India.

B. DUTT and S. N. RAY, Izatnagar.

The haemoglobin content of blood of cattle and buffaloes at different farms in India has been estimated. It is seen that in 40% of the farms, the haemoglobin level is lower than normal. In farms where trace elements mixture is routinely fed, the haemoglobin content is usually normal.

78. Some observations on the Fragility of Erythrocytes of Bengal cattle suffering from Malnutrition.

A. N. GUHA, G.V.Sc., Calcutta.

Fragility of R.B.C. in saline has been studied in two batches of cattle namely, a batch of Haryana cattle in good condition and other from the so called 'Bengal breed' which were undernourished but otherwise suffering from no observable clinical conditions.

It was found that the average resistance of R.B.C. in the normal animals varied from 0.45% to 0.41% of saline and that of the undernourished group varied from 0.48% to 0.47% signifying a somewhat lower resistance power of the limiting membrane of the red blood corpuscles.

79. The Effect of Aeration on the H-ion Concentration in the Rumen of Goats.

SUBODHBIKASH CHOWDHURY and AMAL KUMAR ROY, Calcutta.

The authors studied the normal H-ion concentration in the Rumen contents of goats following ingestion of poor quality hay and the effect of subsequent aeration on the pH of the Rumen contents of goats. Rumen was punctured with a Trochar and Canula and Rumen contents were withdrawn in glass vials. Immediately after collection the contents were covered with a layers of liquid Paraffin and brought to the laboratory. The initial pH were recorded and the samples were then aerated for 10 and 20 minutes when again the pH were recorded. It was found that the initial pH varied from 5.6-6.8. After the aeration for 10 and 20 minutes, the pH recorded at 7.8-9.8 and 4.8-5.8 respectively.

80. Tolerance limit of Argimone oil in Mustard Oil.

D. N. MULLICK, Izatnagar.

Attention has been paid by the Public Health workers in recent years to unfold the causes of epidemic dropsy in men. The present investigation has been arranged to show the limit of adulteration of argimone oil in mustard oil which can produce abnormal physiological conditions in rats.

Synthetic diet was supplemented with different quantities of argimone oil and mustard oil and was given to six groups of experimental animals. The recorded results, on gain in body weight, hemoglobin level and feed consumption, showed that the quantity of argimone oil between 4 to 8 c.c. per 100 gm. of feed showed conspicuous deteriorating effect on the health of the animals.

81. Incidence of Sterility and Infertility in Farm Animals.

B. C. MUKHERJEE, S. K. SAHA and R. B. SINGH, Mathura.

The incidence of infertile and sterile cases was studied in the animals which were artificially inseminated in this laboratory.

Out of the total number of 3093 inseminations studied in case of cows, 76 cases were found to have infertility of temporary nature because these cases responded to treatment and 30 cases did not respond to any kind of treatment and are thus can be branded as infertility of permanent nature (sterility).

In the case of she buffaloes, out of 879 inseminations studied, 46 were found to have suffered from temporary infertility and 17 were found to have permanent sterility.

Expressing the results of analysis in terms of percentage, it can be said that this figure is negligibly small. The incidence of temporary sterility were 2.45 and 5.2 per cent in cows and she buffaloes respectively and that of permanent sterility in cows and she buffaloes were 1% and 2% respectively.

The percentage of sterility in our animals is found to be small but with ban on slaughter, it is expected to create a very big problem.

The cases studied had the following causes for sterility in order of magnitude.

Ovarian diseases including anoestrus ovary, cystic ovary and persistant corpus luteum.

Endometritis.

Cervicitis.

Nutritional deficiencies.

Vaginitis.

Salpingitis.

Persistant hymen.

Constriction of cervix.

The percentage of temporary sterility (which could be treated successfully) has been found to be 72.2% of the total sterility.

82. Effect of month of calving on the gestation period of Indian cattle.

S. S. PRABHU, Izatnagar.

Using the pooled means of 9645 gestation data collected from various farms and breeds in the Indian penninsula, the effect of month of calving on the duration of pregnancy was investigated. It was observed that a significant variation in gestation period, depending upon the month of freshening, occurred in Indian cattle. The highest gestation period (287.00 days) was found in February, and the lowest (284.74 days) in September. In general the longer gestations fell in months where the pregnant animals received less of grazing during the later half of their pregnancy, and the shorter gestations occurred in months where the later half of pregnancies were spent in periods of plenty of grazing.

83. Maturity period in Hariana cattle and its heritability.

R. B. SINGH, J. P. AGRAWAL and I. P. Singh, Mathura.

A study was made about the maturity period (age at first calving) of Hariana breed bred at Mechanised State Farm, Bharari, Jhansi. It was found to be 4 years and 28 days \pm 20.3 days. It shows that our animals mature very late in comparison with the European cattle and that may be one of the causes why cattle breeding in our country is uneconomical. To make an improvement in this character, it is essential to measure its heritability.

The estimates of heritability of this character were made by the method "Resemblance between half sibs" given by Hazel and Terril (1945). The heritability found to be -0.4 ± 0.00574 . It may be due to lack of control on the environmental variations or it may be due to low frequency of genes affecting the heritable variability. This study shows that this character in Hariana breed can not be improved by selection. It may however, be improved by crossing this breed with some other breed of known low maturity period or the feeding and environment may be effective in lowering the maturity period.

84. Effect of Intravaginal administration of bull Semen in immature guineapigs.

A. K. CHOWDHURY and P. B. SEN, Calcutta.

The effect of intravaginal administration to immature female guineapigs were studied to investigate whether the bull semen has got any effect on the reproductive organs in these animals. It was found that after 2 weeks administration all the guineapigs showed a highly significant growth of the uterus and ovary. The pituitary, thyroid and Adrenal glands examined cytochemically showed enhanced physiological activity and an overall development. This indicates that the bull semen contains an oestrogenic substance which is not only active in cows but can act on guineapigs and perhaps all other species of animals.

85. The Influence of Surface Active agents on Rat Growth.

B. N. MAJUMDAR and N. D. KEHAR, Izatnagar, U.P.

The influence of surfactants, santomerse 80 and sterox cO (Monsanto chemicals), on rat growth was studied. Neither of them had a beneficial effect on growth when superimposed on a rice or a wheat basal diet. On the contrary, so far as rat growth is concerned, they may have some inhibitory effects especially when used along with a wheatediet.

86. The Auditory Bulla in the Indian elephant.

M. D. RAJAGOPAL, Madras.

The auditory bulla in three fetuses and in two macerated young skulls of *Elephas indicus bengalensis* are described.

There is a distinct endotympanic in two foetal specimens. In the youngest foetus (C.R. 73.5 c.m.) the endotympanic consists of a thin ossified caudal plate close to the tympanohyal, and a larger and triangular ossified rostral plate whose apex is in close contact with the cartilage of the Eustachian tube. The intervening portion between these two plates is membrane, without cartilage.

In the second foetus (C.R. 91 cm.), the endotympanic is completely ossified forming a single large plate, and separated from the tympanic by a suture, and fused with the tympanohyal and the mastoid portion of the petro-mastoid. In the third foetus and in the young skulls the endotympanic has fused with the tympanic, and a number of foramina and traces of suture probably indicate the site of union.

The endotympanic has been described for the first time in *Elephas*, identified easily in foetal specimens, but found fused with the tympanic in older specimens.

SECTION OF AGRICULTURAL SCIENCES.

President :—DR. S. P. RAYCHAUDHURI, Ph.D. (Lond.),
D.Sc. (Lond.), F.R.I.C., F.N.I.

Abstracts

AGRONOMY

1. Preliminary studies on the seed rate of *Hibiscus cannabinus* L.

A. N. DUTTA and P. SANYAL, Barrackpore

A seed rate experiment with *Hibiscus cannabinus* L. was conducted at the Nilganj Farm, Barrackpore with eight different seed rates starting from 5 lb. to 40 lb. per acre (5, 10, 15, 20, 25, 30, 35 and 40 lb.) in randomized blocks with five replications. The seeds were sown broadcast. The intercultural operations consisted of weeding and mulching and care was taken not to thin the crop plants. The crop was harvested at early-pod stage for the extraction of fibre. The experiment was conducted for three years (1952-1954).

Data on fibre yield was recorded each year and it was subjected to serial analysis. The mortality percentages of plants in different seed rates were also recorded.

The seed rate 15 lb. per acre has given the highest yield of fibre (16-34-maunds) though it is at par with all the seed rates from 10 lb. to 30 lb. at 1% level of probability. With the increase of seed rate beyond 15 lb. per acre the yield of fibre is decreased, the lowest being in the seed rate 40 lb. per acre (12.77 maunds).

The mortality study indicates that the mortality of plants gradually increases as the seed rate is increased from 37.94% in 5 lb. seed rate to 80.96% in 40 lb. seed rate per acre.

The highest yield of fibre in the 15 lb. seed rate has been attributed to better growth and development of the plants and also to optimum plant population at harvest.

The present work indicates that the seed rate 15 lb. per acre may preferably be adopted for broadcast sowing of *Hibiscus cannabinus* L.

2. Effect of Variation in Depth of Cultivation . . . , and Mode . . . Yield . . . Potato.

A. R. KHAN and C. R. SHARMA, New Delhi.

A 'Cultural-cum-manurial', complex experiment on potato conducted at the I.A.R.I. Farm, New Delhi, during Rabi 1954-55, on a sandy loam soil of moderate fertility with pH 7.9, showed no significant differences in yields due to preparation of seed-bed with country plough 4-5" deep; Victory plough 5" deep followed by Country plough; and Tractor plough 9-10" deep followed by disc and grubber. Victory plough cultivation yielded the highest, followed by country plough and the Tractor-cultivation respectively. These results are in line with the observations so far made at the I.A.R.I. Farms, New Delhi and Karnal, during the years 1945-53 on potato as well as other crops like wheat, maize, paddy, sugarcane and cotton, thus indicating that the age-old Country plough, under ordinary conditions, is a dependable implement for general use.

Broadcast application of fertilizers gave significantly higher yields of marketable potatoes and the total produce, at 5% level, as compared to the application of fertilizers in three bands (two side-bands at 4" from and in level with the seed-piece and one 2.0" below the seed-piece). Broadcasting was more effective due to ideal localization of the nutrients, that resulted through the first earthing-up given before the first irrigation.

Nitrogen alone @ 120 lbs. per acre gave significantly lower yields at 1% level than the 80, 120 and 160 lbs. doses of nitrogen, combined with 80 lbs. P_2O_5 and 40 lbs. K_2O ; thus indicating the necessity of P and K in manuring of potato under these conditions. The differences amongst NPK doses, however, were not significant; showing a dose of NPK @ 80:80:40 lbs. per acre as optimum for potato crop in this locality.

3. Relative response of wheat varieties to different nitrogenous and irrigational doses.

A. R. KHAN and B. L. NEMA, New Delhi.

A factorial experiment was conducted at the Indian Agricultural Research Institute farm during 1954-55, to assess the responses of three outstanding, newly-evolved varieties of wheat, namely, N.P. 710, N.P. 718 and N.P. 775. Three levels of nitrogen at 0, 20, and 40 lbs. per acre in the form of ammonium sulphate, each along with a basal dose of 60 lbs. P_2O_5 as superphosphate were applied at sowing. Presoaking dose of 3 inches was given before sowing to ensure proper germination of seeds. Irrigation in different doses of 1, 2 and 3 applications of three acre-inch each were given according to crop needs.

N.P. 718 and N.P. 775 were found significantly better than N.P. 710 in respect of grain yield. The differences between the former two varieties were small and of no consequence. Nitrogen has not given any response in grain yield. It has only increased straw and thereby the total produce significantly. As regards irrigation, it appears that two well-distributed applications in addition to a presoaking dose are about optimum for the crop.

4. Sorghum : Spacing between Rows and Method of Sowing.

B. SEN and S. N. SRIVASTAVA, Almora.

The general sowing practice of Milo (*Sorghum spp.*), by broadcasting the seeds results in poor yield of the crop because the stand is not even and there is a lack of proper intercultural operations.

Experiments were undertaken to find out the proper spacing between rows of milo and also the method of sowing. The main treatments were (i) 1' spacing and (ii) 1½' spacing between rows, and the sub-treatments were (a) sowing by dibbling seeds 6" apart and (b) sowing behind Kutela.

An increased yield of 25% was obtained in case of 1' spacing and the difference in yield is significant at 1% level. There was no significant difference in yield in case of two sub-treatments.

Sowing of milo behind Kutela in rows one foot apart can be recommended to the cultivators.

Expenses of these investigations were met by the Uttar Pradesh Government in connection with the scheme of Development of Food and Fodder Crops at Vivekananda Laboratory, Almora.

5. Preliminary study of the Expenditure pattern of the family budget of Jute-growers.

B. C. KUNDU, S. N. SEN and GIRI, Barrackpore.

The expenditure pattern of the family budget is studied for two income groups with per capita annual income between (a) Rs. 150/- to Rs. 300/- and (b) Rs. 301/- to Rs. 700/-. The rectilinear relationship between the total expenditure and the particular expenditure viz., Food, Clothing and fuel-light as suggested by Engel is verified.

An order of urgency amongst the items and the "income elasticity of demand" of the special items are also measured. It is noted that for lower income group, food and fuel-light are both necessary items while clothing appears to be a luxury item.

6. Root System in two species of Jute.

B. K. KAR and B. K. DE SARKAR, Barrackpore.

The growth and development of root system in clay and sandy loam soils at different ages in case of the two species of jute *Corchorus capsularis* and *C. olitorius* have been studied. The general lay out of the root system in the two species consisted of a well defined elongated tap-root penetrating vertically into the soil. Well developed lateral branches (primary roots) come out at various points from the tap-root. From the primary branches secondary branches were given out which in turn were covered with small fibrous roots.

In case of *capsularis* most of the roots were spread out superficially within 6 to 8 inches of the soil and a zone of maximum branching at the same level was also located on the tap-root which itself penetrated into the soil to a depth of 15 to 20 inches. Numerous adventitious roots were found developing on the upper zone of the tap-root just below the surface of the soil.

In case of *olitorius* the tap-root was more prolonged, penetrating to a depth of 30 to 35 inches. The well developed lateral branches were given out at different levels from the tap-root, spreading obliquely into the soil and giving out branches to reach the lower levels of the soil upto 3 feet. No or few adventitious roots were formed like *capsularis*. No definite zone of maximum branching was noticed on the tap-root.

Comparative growth of root-system in heavy clay and sandy loam soils has been studied. In heavy clay the tap-root was found bifurcated at different lengths in most of the cases. The length and the mode of the spread of the branches were also affected according to the nature and texture of the cultivated land.

From the study of the root-system, the habit of the two species could easily be distinguished. The specific nature of differences in manner of growth and spread of branches in superficial and spreading type (*capsularis*) and deep penetrating type of branches (*olitorius*) had been demonstrated.

7. Effect of growth regulators on weedy crop of Wheat.

H. K. PANDE, Kharagpur.

Comparative effect of sod. 'Methoxone', sod. 2, 4-D and 2, 4-D acid when applied at 1.7 pound rate (acid basis) in 100 gall/acre on weedy crop of wheat was observed for two years. At the time of spraying the chemicals, the crop was actively tillering and the weeds were in seedling stage. The effect of growth regulators were also compared with the hand-weeded and non-weeded checks.

The former two weed-killers brought 60 to 80 percent kill of the weed species—*Chenopodium album*, *Asphodelus tenuifolius*, *Melilotus indica*, *Vicia hirsuta*, *Convolvulus arvensis*, *Fumaria parviflora* and *Anagallis arvensis*, while the latter gave 79 to 94 percent control of these weeds. However *Cyperus rotundus* was controlled only up to 25 percent by 2, 4-D at this rate. The effect of both the salts was more or less equal. As apparent from the outward symptoms, the wheat plants were left unaffected. The weed infestation comprised two third of the total plant population. The suppression of these weeds by the spray treatments of sod. 'Methoxone' sod. 2, 4-D and 2, 4-D acid brought an increase in grain yield of wheat upto 40.2, 38.7 and 35.7 percent respectively. The hand-weeded plots recorded 70.4 percent increase in yield over the unweeded one. The presence of weed under unweeded check reduced the fertile tillers per plant and grain number per ear. The sprayed plots though yielded more than the unweeded check, showed lower yield than the hand-weeded one. 2, 4-D acid treatment showed some tendency towards increasing sterility in florets.

8. The possibilities of Cotton cultivation in the Western Zone of West Bengal.

M. K. MOOLANI, Kharagpur.

The possibilities of cotton cultivation in the State involves mostly the consideration of its agronomic aspects to existing conditions. The soil conditions and climatic factors like temperature and rainfall distribution in different regions were reviewed to correlate the response of cotton with the climatic conditions of the State and it has been seen that cotton cultivation can be taken in the western zone of W. Bengal.

The soil of this region are highly of leaching nature and formed of laterites with ferruginous clay and this zone records temperature from 70°F in winter and 85°F in summer and hence cotton cultivation can be taken as higher temperatures are favourable during that period and upper limit goes much higher during picking season. The rainfall in this zone has been described in four typical months. In April normal rainfall varies from 1"-3" and it facilitates land preparation. Jne rains (8"-10") do not fail to set in and July rainfall (13"-16") is uniform. The month of December is driest month (0.01"-0.25") which is favourable condition for cotton picking.

Under these existing conditions, the performance with normal cultural practices was 200 lbs. per acre which is not at all a discouraging figure under rainfed conditions as compared to 600-800 lbs. per acre with irrigation. When higher yields of cotton are maintained, efforts will be made to improve its quality with regards to staple length, ginning percentage and other economic characters of commercial importance.

The manurial experiment of basic and topdressing doze of optimum yields is under field investigations and further work is in progress.

9. Broadcasting vs. Line sowing in Gram.

NIRAD K. SEN and MANAS K. JANA, Kharagpur.

To compare the performance of Gram sown in the two commonly practised methods viz. broadcasting and line sowing an experiment was laid out in randomised block with 4 replicates. There were six treatments viz. broadcasting with A) 40 lbs. and B) 80 lbs. of seed per acre and line sowing with C) 18"×12", D) 18"×9", E) 12"×12" and F) 12"×9" spacing between and within lines. Germination was good, though in broadcast plots there were several open patches

and in some area plants were densely crowded. Yield per plot in the six treatments were 4.99, 5.88, 6.73, 9.11, 10.78 and 7.92 lbs. respectively i.e. in the order of A B C F D E, insignificant differences among the treatments being joined by lines above or below. It may be concluded that line sowing offers much better potentiality to increase the yield of gram, optimum spacing for this high land lateritic tract will have to be found out by further investigations.

AGRICULTURAL CHEMISTRY AND SOIL SCIENCE.

10. Studies on the fertilizer value of ammonium chloride and ammonium sulphate-nitrate (double salt).

A. B. GHOSH and S. P. RAYCHUDHURI, New Delhi.

The results of the first year's field experiments in progress at I.A.R.I. were presented last year (Proc. 42nd. Ind. Sci. Congr. 1955, Part III) and during the second year of the trials, both the nitrogenous fertilizers, ammonium chloride (26% N) and ammonium sulphate-nitrate (19% $\text{NH}_4\text{-N}$ plus 7% $\text{NO}_3\text{-N}$), gave highly significant increases in yield of paddy over no manure and were fully comparable to ammonium sulphate on equal nitrogen basis, thus confirming the previous year's observations. At 20 lb. nitrogen dose per acre they increased the paddy yield over no manure by 11.5 and 7.4 mds. per acre respectively, compared to 10.9 mds. with ammonium sulphate. The differences in yields between the three different forms of nitrogen were, however, not statistically significant. 40 lb. N dose had no beneficial effect over the 20 lb. one with any of the above three fertilizers.

The mean pH of the soil under fertilized treatments was slightly lowered by 0.2-0.3 units than in control plots. Ammonium chloride at 40 lb. N adds 101 lb. of chloride per acre but after two irrigations the chloride content in surface soil was only 35 lb. more than in no manure plots, the rest being washed away. Its application also resulted in about double uptake of chloride by the crop than in control, major part of it being present in the straw.

Laboratory nitrification studies showed that in the first 10 days ammonium sulphate and ammonium sulphate-nitrate nitrified by about 50% but the rate for ammonium chloride was slower in the early stages, only 20% being nitrified. Subsequently, its rate speeded up and in the following 15 days more than 90% of nitrification was undergone by all the three fertilizers.

11. Studies on the humification of leguminous and non-leguminous weeds in the typical soils of Agra district. Part I. Changes in the nitrogen and carbon content of the Dumat soils in Agra district by humifying the weeds *Pluchea lanceolata* (Baisurai) and *Melilotus alba* (Sainjji).

ABANI K. BHATTACHARYA and B. R. NAGAR, Agra.

Baisurai (*Pluchea lanceolata*, non-leguminous weed) and Sainjji (*Melilotus alba*, leguminous weed) were humified under aerobic conditions in the so called Dumat soils of Agra district. The variations in organic carbon, total nitrogen, ammoniacal and nitrate nitrogen and pH were studied at different periods of humification. The organic matter in the soil increased during the humification of Baisurai and Sainjji as compared to the original untreated soil; but in the case of Baisurai, the total nitrogen was definitely decreased while Sainjji enhanced the nitrogen status. This may be due to the presence of greater nitrogen in Sainjji (leguminous) than Baisurai (non-leguminous). The mineralised nitrogen content in

the soil suffered fluctuations during humification with Sainjji as well as with Baisurai. After a certain period of humification it was observed that the mineralised nitrogen content was on the increase with Sainji but it decreased with Baisurai.

The pH of the soil during humification suffered variations from period to period and the mineralised nitrogen content also seems to be responsible for such changes in pH. It has, therefore, been suggested that the ratio of $\frac{\text{Ammonium Salts}}{\text{Nitrate} + \text{Nitrates}}$ is one of the important factors which contribute to the pH of the soil.

12. Studies on the humification of leguminous and non-leguminous weeds in the typical soils of Agra district. Part II. Variations in the physical properties of the Dumat soils in Agra district by humifying the weeds *Pluchea lanceolata* (Baisurai) and *Melilotus alba* (Sainjji).

ABANI K. BHATTACHARYA and B. R. NAGAR, Agra.

Baisurai (*Pluchea lanceolata*, non-leguminous weeds) and Sainjji (*Melilotus alba*, leguminous weed) were humified under aerobic conditions in the so called Dumat soils of Agra district. The variations in the physical properties—porosity, Stickypoint, Conductivity, Exchangeable and soluble calcium were studied at different periods of humification. At all stages of humification Porosity and Sticky-point were at a higher level than the original untreated soil. It was interesting to note that in majority of cases a qualitative correspondence among the values of Sticky-point, Porosity and Organic Carbon was observed at different periods of humification. A similar correspondence between conductivity and organic carbon was noted at certain intervals of humification. A qualitative relationship between the values of Porosity and Exchangeable calcium was observed in the humification of Sainjji which may be specific with the nature of the system, but it seems to be fortuitous.

13. Studies on the humification of leguminous and non-leguminous weeds in the typical soils of Agra district. Part III. Changes in the physico-chemical properties of Dumat soils in Agra district by humifying the weed *Melilotus indica* (Zoonzhru).

ABANI K. BHATTACHARYA and B. R. NAGAR, Agra.

The so-called Dumat soil of Agra district was mixed with local leguminous weed called Zoonzhru (*Melilotus indica*) which grows in abundance in the certain parts of the district and the periodic changes in the physico-chemical properties of the soil during humification under aerobic conditions were studied in the laboratory. The moisture content of the soil was maintained at 15%.

A gradual decrease in organic carbon was observed. C/N ratio decreased from 9.79 to 5.07 in sixteen weeks and the ratio showed a tendency to stabilise itself at about 5. The total nitrogen status of the humified soil was at a higher level than the original and the variations in mineralised nitrogen suggest strong microbial decomposition of organic nitrogen between 4 to 16 weeks. Sticky-Point and porosity gave higher values for the humified soils. It has been suggested that among other factors the variations in pH during humification depend upon the ratio of $\frac{\text{Ammonium salts}}{\text{Nitrate} + \text{Nitrates}}$ and the amino-acids of amphoteric nature. The conductivity showed ups and downs during the period of humification, the total con-

ductance being much higher in the humified system than in the original untreated soil.

14. Amphoteric character of Kaolinite.

B. CHATTERJEE and A. ROY, Sibpur.

Studies have been made of the adsorption of anions and cations by a sample of hydrogen—kaolinite from a solution of potassium iodide in Acetone, in which potassium iodide is known to behave as a strong electrolyte. The amounts of iodide and potassium absorbed have been found to be respectively equal to 3.85 and 3.90 m.e. per 100 gm. of the minerals. These figures agree closely with the base exchange capacity of this mineral, viz., 3.90 m.e. per 100 gm. The amphoteric character of kaolinite is definitely manifested by the simultaneous adsorption of iodide and potassium ions in equal amounts.

15. Role of Phosphates on the yield and quality of Jute.

B. C. KUNDU, M. K. MUKHERJEE, N. S. RAO and S. C. CHAKRABORTY, Barrackpore.

Nitrogen as promoter of vegetative growth is considered to be most important nutrient for jute which is a best fibre crop. It has been found that one pound of nitrogen usually increase the fibre yield on an average by 8 to 12 pounds. Jute has not responded to phosphatic fertilisers alone, although Indian soils are poor in available phosphates. With the application of higher doses of nitrogenous fertilisers, there is a tendency of lodging of the crop and more leaf fall occurs; with phosphates there is no lodging and leaf fall is less. Soil-fertility so far total nitrogen is concerned improves with the application of nitrogenous fertilisers and with phosphates reverse is the case. Although with addition of nitrogen the yield is higher due to greater vegetative growth, quantity of fibre produced per unit weight of green matter decreases and with phosphates it increases.

Anatomical studies show that wood/bark ratio is more with nitrogen and less with phosphate. With increase in nitrogen, fewer and coarser fibre strands in a fibre wedge are formed whilst with phosphates the fibre strands in a fibre wedge are finer and increase in number. With the application of phosphates the quality ratio of the fibre is improved.

It is, therefore, necessary to have a fertiliser schedule containing both nitrogen and phosphates for having higher yielded, better fibre and for the maintenance of soil fertility.

16. Ion Exchange Equilibria in Non-aqueous Media.

CH. KRISHNAMOORTHY, Bellary.

Before ascertaining the quantitative relationship between ion exchange equilibrium and properties of non-aqueous medium, it is essential to experimentally verify that (a) a complete and reversible equilibrium exists (b) the equilibrium constant is independent of extraneous factors such as volumes of solution phase, concentration of electrolytes, quantity of absorbent, and the complementary ions. In a preliminary study with aqueous alcohol solutions and synthetic resins like Ion X it was found that both the above conditions are fulfilled. Further, it appears that the change of equilibrium constant for similar ion pairs like Na—K may be roughly correlated with the changes in the dielectric constant of the medium.

17. Study of black soils of Madhya Pradesh with reference to their parent rock.

G. C. PADOLEY and R. V. TAMHANE, New Delhi.

In the tropics, weathering phenomena and soil development are expected to be closely related to rocks and rock forming minerals. Therefore a complete understanding of the processes involved, can only be ascertained by giving due consideration to the parent material or parent rock and its mineralogical constituents in the soil. Five profiles of black soils from different parent materials—viz. basalt, mica-schist, metamorphosed limestone with granite, gneissose granite and granite have been studied, for their physical chemical and mineralogical composition.

These soils have practically the same colour, heaviness and generally speaking of the same outward appearance, and reveal on casual inspection no differentiation, but the differences of parent rocks are reflected in the physical and chemical composition of soils as well as clay fractions separated from them. Properties like moisture equivalent, moisture holding capacity and volume expansion, show higher values for soils developed on trap rock than those developed on granitic and metamorphic rocks, indicating thereby a higher content of montmorillonitic type of clay minerals in soils from trap rock. The chemical characteristics of these soils, as far as related to the mineralogical composition of the parent material, also bear a good relationship with minerals present in them.

The clay fraction, however, reveals more clearly the differences that occur due to mineralogical composition of the parent rock. Minerals present in the parent material give rise to different type of clay minerals is a well known fact. The ratio $S/102/R_{23}$ is about 2.0 and SiO_2/R_{23} of 2.5 to 3.3 for clay fractions as well as their high base exchange capacity and the presence of high non-exchangeable magnesium (2.1-4.9%) indicate high proportion of montmorillonite clay. But in clays obtained from micaceous parent rock, the high content of non-exchangeable K_2O (3.2-4.5%) indicate the admixture of Illite and montmorillonite clays. This clearly indicate that minerals like plagioclases and pyroxenes contained in a trap rocks, give montmorillonite clay, while those like biotite and muscovite, present in mica schist, give rise to more of Illite type of clays than the montmorillonite.

Under tropical conditions it is not possible to distinguish between the true parent material and parent rock, since the rock decomposition continue to a great depth. The weathering process and soil, forming process are so inter-linked that separation into geologic and pedologic group is very difficult. Therefore, in order to establish the relation between parent material and soil properties, minerals occurring in above mentioned rocks and their weathering complex have been studied.

AGRICULTURAL SCIENCE.**18. Effect of Phosphatic and Potassic fertilisers on Cotton in the Deccan Canal Area.**

G. V. HAVANAGI and S. K. PATIL, Padegaon.

A number of scattered manurial trials were conducted on irrigated cotton in the Deccan Canal area, during the years 1952-53 and 1953-54. The treatments were as follows :—

N :—60 lbs. Nitrogen. NP :—60 lbs. Nitrogen Plus 100 lbs. P_2O_5 .

NK :—60 lbs. Nitrogen + 75 lbs. K_2O . NPK :—60 lbs. N plus 100 lbs. P_2O_5 plus 75 lbs. K_2O .

The chemical control of these plots was kept up by analysing the original soil samples. The findings of these experiments in short are as follows.

(1) Phosphate application brings early maturity and the effect is more marked if the soil is deficit in available P_2O_5 .

(2) Response to phosphate application is correlated with the available P_2O_5 content of the soil, response being greater wherever available P_2O_5 level is lower than 0.0075 per cent (estimated by Troughs' method). Whereas response to potash is not correlated with available K_2O in the soil.

(3) Combined effect of Phosphate and Potash seems to be superior in general though individual application has its own advantage at times depending upon the levels of P_2O_5 and K_2O in the soil.

(4) No marked effect of these fertilisers on the quality of cotton was observed except for slight increase in ginning percentage in case of NPK treated plot.

19. Determination of available phosphate in soils in the field.

H. SINHA, S. C. LALA and H. N. MUKHERJI, Sabour.

With a view to finding out some suitable extracting solution for the estimation of phosphate in soils rapidly in the field, that should be applicable to all kinds of soils e.g. acidic, neutral and calcareous the solutions of Spurway, Das, Olsen and Morgan were compared. The relative information arrived at by the use of all these extractants is that, except for Morgans extractant, all of them extract phosphates in a proportional manner. From the standpoint of power of extraction from all classes of soils Olsen's solution ($NaHCO_3$) seemed to be quite satisfactory and therefore it was studied in greater detail. The effects of concentration of $NaHCO_3$, soil/solution ratio and period of shaking on the amounts of phosphate dissolved were also determined. It was found that an $\frac{M}{2}$ solution of $NaHCO_3$ occupying twenty times the volume of the soil for two minutes only if shaken thoroughly with the soil would extract fairly estimable quantities of phosphate, relative to the amount present in the soil.

20. Effect of application of Superphosphate to the green manuring crop Dhaincha (*Sesbania aculeata*) in lateritic soils.

J. N. JOHRI, Kharagpur.

Common green manuring crop was drilled in the high land lateritic tract of this region with and without phosphatic manure. Seed rate was 40 lbs. per acre and superphosphate at the rate of 150 lbs. i.e. 25 lbs. of P_2O_5 per acre were drilled. Comparative study made on 68 days after growing before the plants were buried showed, that in unmanured plot the plant population per unit area and moisture content was high. In phosphate manured plot, the average height of plant was more than 6 times while the total dry matter addition was 12 times more than in plots without phosphate.

21. Nitrification studies of soil Nitrogen in Bihar. I. Under Aerobic conditions.

K. K. JHA, R. SINGH and H. N. MUKHERJEE, Sabour.

Bihar soils are known to vary widely in respects of their N contents and their response to Nitrogen manuring. It is, therefore, very important to know the availability of nitrogen in different kinds of Bihar soils. It has been agreed by

many workers all over the world that estimations of total nitrogen, C/N ratio and single determinations of $\text{NO}_3\text{-N}$ and $\text{NH}_3\text{-N}$ are no good for predicting the N availability in a soil. On the other hand many workers favour the adoption of nitrification rate as a test for N availability of a soil. It was, therefore, considered appropriate to test some typical Bihar soils for the rate of nitrification of their native nitrogen under different conditions.

10 upland soils collected from different parts of Bihar were, therefore, initially examined for total N, C/N ratio, pH, NH_3 and NO_3 contents. The soils were then incubated at 30°C with $\frac{1}{3}$ saturation capacity under aerobic conditions and tested periodically for $\text{NO}_3\text{-N}$ and $\text{NH}_3\text{-N}$ contents. No correlation was found between available forms of nitrogen and total nitrogen and C/N ratio; $\text{NO}_3\text{-N}$ and $\text{NH}_3\text{-N}$ contents of the soils, estimated in the beginning, too, did not show clearly the characteristic differences existing among different Bihar soils. Contrary to the findings of some workers, it was found that mineralisation rate of soil N was slow upto 6 weeks' incubation and then rose sharply. On the basis of these results it is suggested, here that for mineralisation tests of soil N at $\frac{1}{3}$ rd saturation moisture contents, incubation upto 8 weeks should be adopted instead of 30 days, so that differences in availability capacity of different soils may be marked out in a better manner.

22. Report on an examination of the method proposed by Alderfer and Merckle for the measurement of structural stability and permeability in soils.

K. L. NAYAR, New Delhi.

An investigation was undertaken to examine, by applying to a large number (48) of soils and subsoils, a simple and rapid method proposed by Alderfer and Merckle (1941) for measuring structural stability and permeability in soils, the accuracy of the values for these indices by correlating and comparing these with other soil constants that are known to affect the properties of a soil in the same direction as those under examination and these included apparent density, total porosity, nature of porosity (capillary and non-capillary) colloidal dispersion and actual rate of percolation.

The statistical correlations worked out showed stability index to be highly and related to total pore space, and capillary pore space, but negatively and significantly related to non-capillary pore space, volume weight and dispersion co-efficient. These relationships point towards the accuracy of the values under examination.

Similar correlations have been reported by the authors of the method themselves between stability index and volume weight, organic matter of the soil. The corroboration of one of these two relationships in addition to four others, as pointed out above for a large number of soils indicate the desirability of adapting this method for determining stability and permeability characteristics of soils in the laboratory.

23. A study of the significance of certain single value properties of soils in relation to their texture.

K. L. NAYAR, New Delhi.

The results are presented of an attempt to check up the relationships established by Keen and Rackzowski between box Constants, Comprised of pore space, apparent density, water taken up by soil, specific gravity, volume expansion and Clay and also to see how far silt fraction in addition to clay influences these Constants in a large number (160) of soils and sub-soils from profiles of not much different type and

origin, but varying in texture. In addition, the significance and importance of Hardy's "index of texture" has also been studied as an easy and quickly determined Constant for defining the texture of soils.

The statistical correlations worked out between different sets of Values revealed that :—

(1) Hardy's index of texture is a very useful single value Constant that should greatly help to give a preliminary and quick textural picture of soils as was shown by very high relationships established between this Constant on one hand and Clay or sand on the other.

(2) The positive relationships were more significant in case of clay plus Silt and pore space, water taken by saturated soil than with clay alone; whereas Volume expansion was significantly related to clay only and not to Clay plus Silt.

(3) The negative Correlations established between clay, Clay plus Silt and apparent density were higher in the later case.

(4) The positive Correlation between Clay and specific gravity was in Contradiction to negative Correlation reported between two values by Keen.

24. A study of the rate of progressive growth of wheat plants grown on soils of different levels of productivity.

K. L. NAYAR, New Delhi.

Periodic observations were recorded on the rate of growth of wheat plans grown under indetical conditions in the fields on 4 soils of known and different levels of productivity for comparing the progressive changes in the vegetative and reproductive phases of the crop in relation to important major nutrients of the soils.

The results indicated that :—(1) Available P_2O_5 and nitrates in the surface and sub-soils, determined to a great extent the productivity of the soils, while potassium was sufficiently supplied and did not, therefore, determine the difference in behaviour of the plants grown on the soils under investigation.

(2) Vegetative growth of the plants, as determined from the ultimate height attained and also from the number of leaves was very vigorous in soils rich in nitrogen, whereas on soils insufficiently supplied with nitrogen, the plants had but a stunted growth.

(3) The supply of P_2O_5 by soils affected the formation of tillers, ears and ultimately the yield of the crop.

(4) Growing period was shorter in case of crop grown on poor soils than on rich ones.

A mathematical expression of the growing period was deduced from Robertson's growth equations as applied by Klages and it was found that the value of K. which represented the general slope of the growth curve was inversely related to the growing period and, therefore, to productivity of the soils.

25. Influence of parent materials on the mineralogical composition of laterites.

K. V. S. SATYANARAYANA and P. K. THOMAS, New Delhi.

Laterites of Malabar have so far been believed to have been formed on acid rocks. In a recent survey of the laterite areas basaltic rocks are also found underlying some areas. The different horizons developed on a basaltic and gneissose rock have been studied. Although morphological differences are less conspicuous there are marked chemical and mineralogical differences. The profile on acid rock contained predominantly quartz and kaolinite while that on the basic rock

showed less of kaolinite and more of gibbsite. Amorphous compounds of iron are present in both the profiles, the basic rocks contributing larger amounts. It is concluded that the mineralogical make-up of the parent materials determines the minerals of the laterite and soils formed from them.

26. A note on the utilization of Retting Water as Fertilizer.

M. K. MUKHERJEE, A. K. KUNDU and G. HALDER, Barrackpore.

The jute fibre of commerce is cellulosic material with a negligible amount of nitrogen. In the retting tanks all the nutrients withdrawn by the plant accumulate and a large quantity remain in water-soluble inorganic form. Some data have been presented so far P and N are concerned as these are the two limiting factors in most Indian Soils. It has been found that if retting water enters paddy fields, the crop is not affected whilst in the contiguous plots the plants may be diseased. The water from paddy fields show that wherever retting water enters, the amount of inorganic soluble P was very high in comparison with neighbouring plots.

27. Preliminary experiments on the effect of addition of gypsum and calcium chloride on percolation of saline soils.

N. M. NIMGADE, New Delhi.

A preliminary study has been made of the chemical method for reclaiming the Gheora soil found to be saline and the surface sample of which has shown to contain 1.33% of water soluble salts.

Mere leaching with 10 acre inch water proved to be effective in removing about 75% of the total soluble salts in the leachate, under laboratory conditions. Application of 2 tons of gypsum before leaching with 10 acre inches of water as well as leaching with 20 acre inches of water is as good as the application of 5 tons of gypsum. CO_2 was found to be present in the leachate in larger quantities than in the original soil. This is peculiar and needs further investigation. Addition of increasing concentrations of calcium chloride to the soil leads to increasing concentrations of soluble salts being leached out. Application of 2 tons of calcium chloride per acre for leaching is as effective as applications of 5 tons per acre in removing soluble salts. Also calcium chloride proved more effective than additions of equivalent amount of gypsum.

The data show that the rate of percolation increased with addition of increasing doses of calcium chloride.

It was found that under laboratory conditions leaching of saline soils after addition of gypsum and calcium chloride removed increased amount of total soluble salts as compared to leaching with water, from the soil, and calcium chloride was more effective in this respect than the gypsum. The economy of using calcium chloride under local conditions is however a factor which has to be taken into consideration in advocating its use for reclaiming saline and alkaline soils.

28. Oxidation-Reduction or Redox Potential of some typical paddy and Acid Soils.

O. P. DHAMIJA, R. S. MURTHY and S. P. RAYCHAUDHURI, New Delhi.

The oxidation-reduction equilibrium of soils has had scant attention from those interested in soil problems. There can be no doubt that it constitutes an important soil property. The availability of Iron and Manganese, the two

most essential minor elements required in the growth of rice plants is governed by the oxidation reduction or redox potential in soils which plays a prominent role in paddy soils. Investigations have been carried out in establishing relationship between Iron and Manganese in some of the typical paddy soils of Bihar, Uttar-pradesh and Punjab and acid soils from the Sinchona estates of Darjeeling by finding out the redox potential and the factors affecting the oxidation-reduction equilibrium.

Manganese occurs in soil in different forms with widely divergent solubilities and depends upon a number of factors of which pH and organic matter content are the most important. The easily reducible manganese is a very important fraction in identifying the manganese deficient soils. In light of the wide variation in the availability of different forms of manganese and the important part it plays in controlling the oxidation and reduction of iron in soil, the redox potential (Eh) of these soils have been worked out. It is seen that Eh is directly proportional to pH and organic matter tends to lower the redox potential of soils.

From the results it can be concluded that the function of manganese and iron are interrelated and they act as complimentary oxidation-reduction reagents and they keep each other in equilibrium at a fixed potential.

29. A method of classification of alluvial soils based on their age, morphology, nature and frequency of flooding crop adaptation.

P. P. JHA, S. C. MANDAL and H. N. MUKHERJI, Sabour.

During the course of survey of the alluvial soils of Sabour National Extension Block composed primarily of the Gangetic alluvium and of the Koshi alluvium in Saharsa district, it was observed that the texture or other morphological characteristics of the subsoils cannot form a useful basis for the classification of these soils into series category. This is due to the fact that the texture, consistency and other characteristics of layers below the subsoil influence drainage as well as moisture retention of upper layers and consequently, crop patterns. Moreover, many of these soils being subjected to annual, periodic or cyclic inundation, the height of the water table at different periods of the year, salt contents, oxidation, reduction reactions, drainage, moisture retention etc. of these soils are entirely different from those laying in another alluvial belt, not subjected to floods, but having identical subsoil characteristics. Thus a new scheme of classification of these soils has been suggested. Soils may be grouped into old and young alluviums. The young alluviums may be subgrouped according to the nature and duration of inundation, if any. Further, all these soils may be classified according to depth and each depth class be subdivided according to the texture of the subsoil. Further differentiation may be achieved by comparing other morphological characteristics of subsoils or by distinguishing crop adaptations as in very shallow alluviums, recently deposited.

30. Rate of water intake of the soil under different soil treatments.

RALPH C. HAY and T. K. SUBRAMANYAM, Kharagpur.

A preliminary study was made of the infiltration capacity on the Indian Institute of Technology Campus soil which is a lateritic sandy loam. Three soil treatments were considered for this purpose namely Bare land without vegetation, Scrub forest land and Ploughed land. For this study 6" diameter steel cylinders were forced into the soil, the same filled with water to a depth of 8" and measure-

ments taken of the subsidence of water for seven hours at convenient intervals of time. There was a decline in intake rate of water with time which was very rapid at first but became steady and finally reached a constant rate by about five hours. The intake rate decreased in the order of ploughed land \angle Scrub forest land \angle Bare land. Even though the initial moisture contents of the Ploughed and Scrub forest lands were considerably higher than the Bare land, still the infiltration capacity of these two greatly exceeded that of the Bare land. The high infiltration capacity of the Ploughed land in spite of its highest initial moisture content indicates that the top soil condition plays the most important part in determining the intake rate of these soils. Proper cultivation of the land or keeping the land under forest, favoured the amount of water that could be made to percolate through the soil and reduced the amount that moved over the surface, with the consequent reduction in runoff and soil loss.

31. A preliminary study of the sands of Sahasra District.

S. SAHAY, P. P. JHA and S. C. MANDAL, Sabour.

In course of the Survey of The Soils of Sahasra District, most of which has been the flood plain of the river Koshi and its branches during the last few decades, it was observed that sands deposited in different layers of profiles at different places had variable colour and mineralogical composition. In order to make a rough estimate of the mineralogical composition of these sands, samples were collected from the sand layers of a number of profiles and they were examined with the help of petrological microscope. The sand particles were observed to be rounded, angular and subangular in shape, caused by river action. They contained variable proportions of minerals quartz, feldspars (orthoclase microcline, albite, plagioclase), micas (muscovite, sericite and biotite) magnetite, ilmenite, limonite hornblende, chlorite, zircon, garnet, chalcedony, leucosene and red quartz. Many of these minerals were observed to be pure as well as altered products. Quartz forms the predominant fraction. On an average it constitutes 50 per cent of the sand followed by feldspars (30 per cent) and micas (15 per cent). Different colours of sands are due to the presence of iron oxide, black micas, ferrous sulphide or red quartz. Ripple marks were also observed in the sands. They are both symmetrical and asymmetrical and have been formed by the oscillation of stationary bodies of water as well as by the current of water.

32. Effect of ecological factors and traumatism on juice quality. Part II : Effect of Frost on Sugarcane Crop.

S. C. SEN and J. C. BHARGAVA, Kanpur.

Consequent on a depression in sugar recovery during the optimum production period, January and February, 1955, in sugar factories of Dehradun and Rampur districts, a survey was instituted at the request of the Government of Uttar Pradesh, to enquire into the causes thereof and the work done in this connection strongly suggested an association between the observed fall in the sugar recovery and the depression in juice quality of standing crops affected by frost. An analytical examination of canes affected by frost against normal canes (unaffected) showed that juices of affected canes suffered a set back in sucrose content accruing 4-5 units at Deiwala district and 3-4 units at Rampur district. Besides, the intensity of affection due to frost has been found directly proportional to the fibre content. Higher the fibre content lesser is the degree of affection.

33. Effect of Trace Elements and Presence and Absence of Organic Manure.

S. G. JOSHI, Poona.

In this experiment the five trace-elements Cu, Mn, Mo, B and Zn, considered to be essential for plant-growth were separately tried to see their effect on the yield of wheat plants, in presence and absence of organic manure.

Seventy two pots were filled with one and the same thoroughly mixed sample of poor-crop yielding soil. There were twelve different treatments and six replicates for each treatment. The twelve treatments comprised of (1) control or no treatment, (2) organic manure and the remaining ten were applications of the five trace-elements in presence and absence of organic manure.

It is observed that in the absence of organic manure, application of copper oxide to the soil produces a lowering in the yield while the addition of oxides of manganese and molybdenum, zinc carbonate and boric acid produces an increase in the yield of wheat over the control. The reduction and increase in the yields obtained by the addition of the trace-elements are, however, not statistically significant.

Treatment with organic manure has given a large significant increase in the yield which is above 70 per cent more than that of the control.

The addition of manganese salt together with organic manure has reduced the yield while the other four trace elements in presence of organic manure increased the yield, when compared with that in pots treated with organic manure alone. The increase with treatments (Org. M. & B.) and (Org. M. & Zn) is found to be very high and statistically significant.

It is thus observed that the response of the wheat plants to the addition of copper, manganese or molybdenum in the presence or absence of organic manure to this particular soil is not significant while the addition of zinc and boron in the presence of organic manure gives a large increase in yield.

34. Soils of Lower Gangetic Alluvium.

S. K. MUKERJI, Calcutta.

Schematic type of soil survey was adopted to study the soils of lower gangetic alluvium. Preparation of schematic soil map from spot observations was undertaken. The profiles were studied at 6 mile grid-intersection points. Soil profiles were examined upto a depth of 4 ft.

All such soil associations which have originated from the alluvium laid down by the Ganges and situated in the natural regions, formed as a result of the physical features and water sheds of the River Ganges have been given the family name Ganga alluvium.

The soils of each of these families have been subdivided into several soil associations. Topography, mode of formation, the design and the development of the profiles are the major considerations in setting up of four profile groups or associations in the family of Ganga Alluvium.

They are :

1. Ganga Riverine Lands
2. Ganga Flat Lands
3. Ganga Uplands
4. Ganga Low-lands.

Ganga Riverine has two phases :

- (a) Inundated phase—Ganga Riverine Chars.
- (b) Highland phase—Ganga Riverine Ridges.

35. Soil acidity study in the District of Howrah.

S. P. CHATTERJEE and S. N. MUKHERJEE, Calcutta.

A Soil Acidity Survey in the District of Howrah in the State of West Bengal has been conducted by us. A micro-relief feature was also investigated. The work of Troug, Russel and Kubierna go to prove the usefulness of this work.

The soil pH was observed in 1:2.5 soil to water ration and the pH was determined with glass electrodes of a pH meter. The soils are classified into five distinct categories viz. strongly acidic, weakly acidic, neutral, weakly alkaline and strongly alkaline.

The soil pH map shows the following characteristics :

(1) Neutral soils occupy more than 50 per cent of the area. It is found scattered all over the district, wherever newer alluvium was found to be deposited in depressions at or near the water table.

(2) Acidic soils predominate in the northern part of the district, some areas being strongly acidic. The cause of acidity was traced to the slightly higher micro-relief of the land and continuous cropping without proper liming.

(3) Alkaline soils predominate in the eastern part of the district, along the river Bhagirathi. The higher content of carbonate and bicarbonate in the soils were due to the presence of these salts in the river water, which usually overflowed the banks.

The study of soil pH and land use of the area reveal that soil pH controls the utilisation of land.

36. Research work on the improvement of furnaces for the manufacture of Gul in the State of Bombay.

During the course of implementation of sugarcane development scheme in Bombay Deccan, intensive publicity was given to the advocacy to utilization of trash for compost making. It was observed that in addition to bagasse a fairly large quantity of sugarcane trash was being burnt as fuel for the purpose of boiling the cane juice in the process of gul manufacture. The quantity of trash so used was estimated to be over 50 per cent of the total quantity produced per acre and the total consumption of trash as fuel in the State of Bombay was estimated to be 8,82,000 tons during the year 1949-50. Thus it is obvious to see that such a large quantity of trash burnt up as fuel if not whole of it at least a part of it could be useful for compost making if the gul furnace designs could be improved upon with a view to minimise the fuel consumption.

The object of this research was to improve the engineering design of the Poona single furnace with a view to economise the fuel consumption and thus avoid the waste of trash used as fuel in the manufacture of gul. The investigations were carried out at the Sugarcane Research Station, Padegaon, District Poona.

As a result of this research work the improved furnace design no. 3 was evolved. It was observed that improved design No. 3 has highest thermal efficiency with minimum fuel consumption of 19.49 lbs. and an average consumption of 26.02 lbs. when compared with the Poona Control Furnace having minimum fuel consumption of 28.34 lbs. and average consumption of 34.25 lbs. of moisture free bagasse. When compared with Poona furnace the improved design No. 3 shows less fuel consumption and lower carbon content in ash thus indicating its superiority over the former. The main features of the improved design No. 3 are as under :—

1. Optimum supply of requisite air,
2. Fuller combustion,

3. Adequate grating area, and

4. Double air port with air port controls and the height of 4'9". It is observed that a grating of 3 ft. diameter with spacing $1\frac{1}{4}" \times 18"$ with air spacing gave highest thermal efficiency. 12 sq. ft. of air supply through the air ports gave the optimum conditions for combustion.

36A. Potassium-supplying potentialities of soils in Deccan.

KUMARI V. S. LAD and D. K. PATEL, Padegaon.

Sixty ton crop of Sugarcane normally removes about 600 lbs. of K_2O per acre from soil in Deccan. In spite of this, the cane crop does not generally respond to potassic fertilisers in Deccan Canal Soils having about 600 to 800 lbs. of available K_2O and does not develop deficiency symptoms in Kolhapur soils having about 450 lbs. of available K_2O . This indicates that these soils have some form of potash, other than available (readily) which can be utilised by crops. This reserve potash called as fixed or moderately available potash has an important bearing in manurial advisory work, specially for a long growing crop like sugarcane.

Hence, the potassium-supplying potentialities of major soil types of Deccan Canal area and Kolhapur soil, were determined by successive extraction of soils with N. Ammonium acetate after alternate wetting and drying of soils for about two months under normal atmospheric conditions, making the soil free from extracting agent every time prior to wetting and drying. This process of extraction was repeated till only traces of potash remained. Alternate wetting and drying on water bath for a period of one week was found equally satisfactory as a short cut. These studies have shown that Kolhapur soils have about 100 per cent more and Deccan Canal soils have about 100 to 200 per cent more of fixed or moderately available potash in addition to the readily available (exchangeable) potash, normally determined.

A simple rapid method has been tentatively evolved to determine potassium-supplying potentialities of soils, as follows.

Five grams of soil (passing through 1 mm. sieve) is extracted with 0.05 N HCl. using 1 : 100 soil to extractant ratio, shaking for 30 minutes in an end-over shaker, and determining potash in the extract. N HCl equivalent to destroy free lime in calcareous soils, is added extra, after the addition of extracting reagent. The work is further continued to streamline the method.

26B. Modification of Hissink's method to determine exchangeable calcium in calcareous soils containing free gypsum.

M. A. MIRAJKAR and D. K. PATEL, Padegaon.

Occurrence of free gypsum in calcareous soils—'B' type in Deccan Canal Area creates interference in the estimation of exchangeable calcium, even when the Hissink's modified method (Crowther and Basu) is employed. The method has been further modified to obviate the interference of gypsum as detailed below.

Ten grams of soil with 2.5 gms. of $CaCO_3$ are washed 4 times with 50 cc. of hot water to wash out soluble sulphates, taking care to transfer the least soil material to the filter paper and allowing to drain thoroughly each time. The filtrate is rejected. The sample with a little quantity of sodium chloride solution is allowed to stand overnight. Then, using the same filter paper, extracting with hot ($70^\circ C$) N. sodium chloride solution, using 100 cc. each time, shaking for 15 minutes, allowing to stand for 45 minutes and filtering the supernatant liquid, is continued till 500 cc. of the filtrate is collected. A blank with 2.5 gms. of $CaCO_3$,

is run simultaneously. An aliquot of the filtrate is taken and titrated for bicarbonates and calcium is determined in this aliquot. Sulphate is also determined in an aliquot. Calcium equivalent to Sulphate as well as calcium equivalent to bicarbonate is deducted from the total calcium found in the extract. Moreover, the calcium other than bicarbonate calcium in the blank, is also deducted to arrive at true exchangeable calcium.

AGRICULTURAL ENTOMOLOGY.

37. Note on the Locust visitation of Orissa in 1954 and 1955.

G. C. SENGUPTA, Bhubaneswar and B. K. BEHURA, Cuttack.

Orissa was visited by not less than three swarms of the desert locust *Schistocerca gregaria* (Forsk.) between November 1 and December 23, 1954. Of the 13 districts, parts of 8 districts viz. Sambalpur, Bolangir, Kalahandi, Boudh-Khondmals, Ganjam, Puri, Dhenkanal and Keonjhar were affected. Whereas the locusts visited the State during summer (May and June) in 1951 and 1953, the attack in 1954 took place in winter. The standing crops at the time of locust attack consisted of mustard, coriander, horsegram, castor, potato, tobacco etc., of which mustard crops were usually completely defoliated, while castor plants were nibbled at and other crops were left untouched. An account of the extent of damage in different districts is given.

In 1955, the locusts were sighted over Boudh (Phulbani Dist.) and Daspalla (Puri Dist.) on the 3rd June. They are not known to have done any damage to crops.

38. Time of exposure and mortality relation between D.D.T. and *Anomis sabulifera* Guen (Jute Semilooper).

N. DUTTA and R. N. GANGULI, Barrackpore.

Concentration of 0.5%-0.75% D.D.T. (WP) is generally used in the field for control of jute semilooper—*Anomis sabulifera* Guen. High concentration is pre-control for field use to obtain a quick kill of the late instar caterpillars and to avoid the adverse weather action on the insecticidal deposit, though lower dosages like 0.25% are effective against the earlier instars. It is observed after spray operation in a field that a certain percentage of caterpillars move away from the field. Tests were accordingly carried out in the laboratory to ascertain the relation of time of exposure and mortality between D.D.T. (0.75% WP) and jute semilooper in which time of exposure was varied from half-an-hour to five hours keeping the concentration of D.D.T. constant. During the period of exposure, caterpillars were allowed feeding on treated leaves. It is found that an exposure of half-an-hour can bring a high per cent of mortality afterwards though there is no mortality during the actual period under exposure.

In treatments with half-an-hour exposure, 20% of the caterpillars survived. With different time of exposure like, 1 hour, 1½ hours, 2 hrs., 2½ hrs., 3 hrs., 3½ hrs., 4 hrs., 10%, 5%, 3%, 3%, 1%, 1% survived respectively. While 100% mortality was obtained within the period of exposure when the caterpillars were kept in the treated field for 5 hrs. In treatments with 4½ hrs. exposure though 100% mortality was not obtained within the period of exposure, there was no survival and 100% mortality was obtained within a total period of 6½ hrs.

Thus with the increase in the time of exposure, there is corresponding reduction in the period and increase in the rate of mortality.

39. Comparative effectiveness of some insecticides for control of *Anomis Sabulifera* Guen (Jute Semilooper).

N. DUTT and R. N. GANGULI, Barrackpore.

Folidol, Endrin, Dieldrin, Aldrin and D.D.T. (WP) were tested under the laboratory condition against the third and fourth instar caterpillars of *Anomis sabulifera* Guen. Various concentrations of these insecticides were used in the test. It is observed that a concentration (active insecticidal ingredient) of 0.004% Folidol can bring 100% mortality within two hours; 0.03% Endrin (WP)—80%, 0.75% D.D.T. (WP)—57.5%, 0.4% Aldrin (WP)—40% and 0.4% Dieldrin (WP)—35% within the same period.

Folidol and Endrin is thus superior to D.D.T. and their cost per acre as per above dosage is also much less in comparison with D.D.T.

40. Comparative toxicity of the films of modern insecticides to the first stage larvae of some internal feeders.

S. PRADHAN and R. N. PRASAD, New Delhi.

Results of trials of some modern synthetic insecticides in the form of films against first stage larvae of *Earias fabia* Stoll, and *Earias insulana* Boisd. are reported. The insecticidal films of known deposits per unit area were prepared on glass surfaces (petri-dishes). Freshly hatched larvae of the test insects were exposed to these films for half an hour. Thereafter these larvae were reared under optimum conditions and the effects, if any, were observed till death or the whole period of further development till the next egg stage (in case of survivors).

The insecticides tested in the case of *Earias fabia* were: (1) DDT, (2) gamma BCH, (3) chlordane, (4) toxaphene, (5) aldrin, (6) dieldrin, (7) isodrin, and (8) endrin. In case of *E. insulana*, three insecticides (Nos. 1, 5 & 8) were tested.

The values of LD_{50} (expressed in microgram/sq. inch of deposits) were calculated and were found to be for DDT 2.7, gamma BHC 1.5, chlordane 3.18, toxaphene 3.6, aldrin 0.5, dieldrin 0.15, isodrin 0.13 and for endrin 0.026 in case of *E. fabia*. Taking these values of LD_{50} as index of toxicity, endrin, isodrin, dieldrin, aldrin and gamma BHC were found to be more toxic than DDT i.e., 103.8, 19.8, 17.5, 5.05 and 1.8 times respectively as toxic as DDT, while chlordane and toxaphene were less toxic than DDT i.e., 0.85 and 0.76 times respectively as toxic as DDT.

In case of *E. insulana* the values of LD_{50} (expressed in microgram/sq. inch of deposits) were calculated and were found to be for DDT 4.035, aldrin 1.023 and for endrin 0.022. Thus endrin and aldrin were more toxic than DDT i.e. 183.4 and 3.9 times respectively as toxic as DDT.

ZOOLOGY AND ENTOMOLOGY

41. Significance of insect damage in stored Groundnut Kernels.

S. B. KADKOL, S. V. PINGALE and M. SWAMINATHAN, Mysore.

Groundnut kernels were stored in jute bags and subjected to damage by *Corcyra cephalonica*, *Tribolium castaneum*, *Oryzophilus surinamensis* and *Necrobia refipes* under controlled conditions and effects on hygienic conditions, nutrients and free fatty acids were observed. It is shown that insect infestation has not significantly affected the Nitrogen content but has caused an appreciable reduction in thiamine and an increase in free fatty acids. All the insects brought about

practically a similar change in the free fatty acids. The oil obtained from the infested samples was turbid and contained insect fragments. The suspended material responsible for turbidity was rich in uric acid, suggesting its origin from insect excreta.

42. A study on the action of some Grain Fumigants on the Microflora of stored Jowar.

S. K. MAJUMDER, M. V. SHARANGAPANI and S. V. PINGALE, Mysore.

Technical grade ethylene dichloride and carbon tetra chloride mixture, carbon tetra chloride, ethyl bromide, methyl bromide and ethylene dibromide, the commonly available grain fumigants, were used in different concentrations on moist jowar and the changes observed in the activities of the microbes present on the grain were studied. It is shown that the bromides were all helpful in checking the growth of the microbes. Large scale tests undertaken with ethylene dibromide and methyl bromide are reported. Ethylene dibromide is shown to be superior for practical use. The retention of the chemical by the grain is found out and is observed to be much within permissible limits.

43. Identification and estimation of Chlorinated Insecticides on foods.

S. K. MAJUMDER and S. V. PINGALE, Mysore.

History of the insecticidal treatment is a prerequisite in the estimation of the residues on foods for the known methods. It is however, considered difficult to get such history in all cases with an increase in the number of insecticidal chemicals. A technique for the detection, identification and measurement found suitable in routine assays of the commonly available chlorinated insecticides has therefore been reported. Detection through insect response, identification by way of crystallization (by sublimation technique) and estimation by labile chlorine method for each of the chemical is proposed and relevant data are presented.

The results of estimation on cereal grains and some fruits carrying known and unknown residues are mentioned in support of the sensitivity of the technique.

AGRICULTURAL METEOROLOGY

44. Some outstanding examples of the effects of weather in crops over wide areas.

A. K. MALLIK, Poona.

The yield of paddy, cotton and wheat, recorded at a network of stations under the all India "Coordinated Crop-Weather Scheme" for the years 1946-47 to 1954-55 are presented in tables in such a way that the markedly good and markedly bad years stand out prominently.

It has been shown that in peninsular India, (1) Of the three crops viz. paddy, cotton and wheat, the year to year variation in the yield is the least in the case of paddy and greatest in the case of wheat.

(2) The poor yield of paddy at Chinsurah (West Bengal) and Labhandi (East Madhya Pradesh) in the year 1952-53 was due to deficient south-west monsoon rains.

(3) The failure of the cotton crop at Parbhani (North Hyderabad), Nagpur (West Madhya Pradesh), Akola (Berar) and Jalgaon (Bombay-Deccan) in the

year 1949-50 was due to too many rainy days and excessive rain over the whole area during September and October, 1949.

(4) The failure of the wheat crop in 1946-47 due to a severe epiphytosis of rust was brought about by prolonged wet spells and excessive rains during November 1946. These rains were the direct result of the passage of three storms across the area during November 1946. The tracks of the three storms and the rainfall caused by the storms are shown in a figure.

45. Effect of air temperature on the yield of Wheat.

A. K. MALLIK and V. K. SUBRAMANIAN, Poona.

Under an experiment conducted at the Central Agricultural Meteorological Observatory at Poona, Niphad 4 wheat was sown once every fortnight from 1952-'54. The results of this experiment covering 40 different dates of sowing are discussed in the paper.

The following correlation coefficients (r) were obtained.

$$\begin{aligned} r_{xh} &= -.4863^{**} & r_{nh} &= -.4226^{**} \\ r_{xy} &= -.4069^{**} & r_{ny} &= -.2875^{**} \end{aligned}$$

(** Significant at 1% level).

Where x =mean daily maximum temperature during the period from sowing to ear-emergence.

n =mean daily minimum temperature during the period from sowing to ear-emergence.

h =height at ear-emergence, and

y =yield of grain per tiller.

The value of the multiple correlation coefficient

$$R_{y-xn} \text{ was } .4992^{**}$$

It is concluded that warm days during the growing period tends to increase both height and yield of wheat plants and vice versa but while warmer nights also tend to reduce the height, the yield is not affected by night temperature.

46. Studies on the correlations between total leaf area and areas of selected leaves in sugarcane.

P. S. SREENIVASAN, P. S. NAYAR and A. L. JOG.

Amongst the various factors that contribute to the crop growth, the development of tissues wherein the photosynthetic processes take place is a very important one. Perhaps the dimensions of leaves will be a good index of these processes. At present all the fully opened leaves on plants selected by random sampling are measured in the Co-ordinated crop-weather studies on sugarcane. In this paper an attempt has been made to find out whether area of a leaf or areas of two leaves can represent the total leaf area so that the present observations on all leaves could be simplified to a large extent. These studies have been made by simple correlation methods and it has been found that the areas of the second and $(n-1)$ th fully open leaves give correlations of the order of .9 while that of the middle leaf gives a slightly less correlation with the total leaf area.

BIOCHEMISTRY AND ORGANIC CHEMISTRY.**47. Effect of Micro-element fertilizers on wheat.**

M. N. SADAPHAL, and N. B. DAS, New Delhi.

Field trials were carried out to investigate into the effect of micro-elements on the yield and quality of wheat. Micro-elements as sulphates were applied to the soil as well as to the leaves by spraying at the time of flowering in conjunction with a basal dressing of NPK. The doses for soil application were 5 lb. of the element per acre in case of Cu and Zn and 10 lb. of the element per acre in case of Mn and Mg. The dose for spraying was 1 lb. of the element per acre for all the micro-elements studied. Experiments were carried out during 1953-54 and 1954-55.

In both the seasons, soil application of Mn, Mg or the mixture of the micro-elements, and spray application of Cu or Mg, increased the yield of grain. The average increases were of the order of 31.5%, 18.5%, 25.5% 17.0% and 20.5% respectively. Besides these, in the experiment carried out during 1954-55, the yield increases observed in case of Cu and Zn in soil treatment and Mn and Zn in spray treatments, were also significant, the percentage increase in these treatments being 20, 21, 13 and 14 respectively.

Based on the data of chemical analysis for the season 1953-54, the following observations are made :

(i) Addition of either Mn or Cu to soil, increased the protein content of grain. Similar beneficial effect of the spraying of either Zn or the mixture of all the micro-elements was also observed.

(ii) Micro-elements whether applied to the soil or as spray, increased the yield of grain protein per acre. Cu, Mn, Zn, Mg and the mixture of all these increased the yield of protein per acre by 19.0%, 52.0%, 11.8%, 20.0% and 26.0% respectively in case of soil treatments and by 22.3%, 5.9%, 21.5%, 25.2% and 16.8% respectively in case of spray treatments. All the increases, except that in case of Zn in the soil application and Mn in spray application, were significant.

48. Studies on the stability of Lycopene in Tomato products.

N. S. KAPUR, Mysore and E. R. COLE, Sydney.

Studies on the stability of the carotenoid pigment, lycopene, with particular reference to the mechanism of colour loss of processed tomato products were carried out.

The stability of the carotenoid pigment, lycopene, has been studied under various conditions.

The effects of heat, light, copper catalysis and oxidative degradation have been investigated and some of the degradation products have been characterised.

Finally the extent to which loss of natural pigment contributes to the loss of colour in various processing conditions of tomato products has been determined.

49. Thiamine content in pure strains of pulses.

Y. P. GUPTA and N. B. DAS, New Delhi.

Pure strains of pulses grown in two subsequent years were analysed for their thiamine content by the microbiological method. Growth was measured by turbidity as well as by titration and the results obtained by both the methods agreed well.

Different pulses analysed here differed considerably in their content of thiamine ranging from 3.06 microgram per gram to 8.62 microgram per gram. It was also observed that the content of this vitamin varied in different strains of the same pulse in certain cases as well as in the same pulse grown in two subsequent years. No relationship was found between the content of this vitamin and their corresponding protein content.

50. Nutritive requirements of *Lactobacillus leichmannii*.

Y. P. GUPTA and N. B. DAS, New Delhi.

In view of the inadequate knowledge as to the growth requirements of *L. leichmannii*, investigations were taken up in the first instance to study their amino-acid requirement. Strain ATCC 4797 was selected for this purpose. It was found that the growth obtained by 14 amino-acids (dl-alanine, l-tryptophane, l-arginine, dl-valine, dl-glutamic acid, dl-threonine, l-histidine, l-leucine, dl-aspartic acid, dl-serine, dl-phenylalanine, l-cystine, l-lysine, and dl-tyrosine) including dl-alanine was as good as that obtained by 20 amino-acids used for the growth of this organism. It was of interest to note that the presence of dl-alanine was essential for the growth of this organism. In the absence of this non-essential amino-acid, *L. leichmannii* failed to grow altogether. The role of dl-alanine in the growth of this organism is being studied.

Further it was found that aspartic acid-asparagine and glutamic acid-glutamine are replaceable to one another.

50A. Studies on Tree Leaves as Fodder : *Albizzia lebbek* (Siras) leaves.

N. D. KEHAR and B. S. GUPTA, Izatnagar, U.P.

Siras is a deciduous tree 12 to 20 meters high and is distributed throughout India.

The percentage chemical composition of *Siras* tree leaves (on dry matter basis) was found to be : crude protein, 16.81; ether extract, 3.97; crude fibre, 31.52; nitrogen-free-extract, 36.16; calcium, 3.60 and phosphorus 0.35.

To determine the nutritive value, these leaves were fed *ad lib.* as sole feed to six adult sheep of similar age and body weight for 30 days the last seven of which constituted the metabolic period. These leaves were relished from the very beginning. The average consumption of these leaves on dry matter basis was 2.77 lb. per 100 lb. body weight which is fairly high and indicative of good palatability.

The average percentage digestibility coefficients for crude protein, ether extract, crude fibre and nitrogen free extract were found to be 66.6, 9.9, 40.9 and 67.5 respectively. The animals exhibited positive balances for calcium and nitrogen but phosphorus balances were slightly negative. The digestible crude protein, total digestible nutrients and starch equivalent values in lb. per 100 lb. dry matter of leaves were found to be 11.19, 49.30 and 30.23 respectively.

It is concluded from the above observations that *siras* tree leaves are fairly palatable and nutritious.

50B. Studies on Tree Leaves as Fodder : *Morus alba* (Tut) leaves.

N. D. KEHAR and M. M. JAYAL, Izatnagar, U.P.

The percentage composition of leaves (on dry basis) was found to be : crude protein, 15.00; ether extract, 7.43; crude fibre, 15.27, nitrogen-free-extract, 47.98, total carbohydrates, 63.23, ash, 14.32; calcium (CaO), 3.38 and phosphorus (P_2O_5) 0.46.

To assess the nutritive value of *tut* leaves six adult sheep were selected. *Tut* leaves formed the sole feed of the experimental animals. The animals, on an average, consumed 1560.4 gm. or 3.44 lb. leaves on dry basis per 100 lb. body weight per day which indicates that the leaves were highly palatable.

The digestibility coefficients, on an average, for crude protein, ether extract, crude fibre and nitrogen-free-extract were found to be 71.20, 3.59, 54.13 and 83.47 respectively. The digestible crude protein, total digestible nutrients and starch equivalent values in lb. per 100 lb. of leaves, on dry weight basis, were found to be 10.68, 59.59 and 50.46 respectively. The animals maintained their body weights during the feeding regime and displayed positive balances for nitrogen, calcium and phosphorus.

These observations show that *tut* leaves are highly palatable and nutritious and can be used as a maintenance ration for sheep. The extremely narrow nutritive ratio of 1:4 coupled with the high palatability of the leaves tend to show that the leaves could meet the requirements for production also at least to some extent.

50C. Studies on Tree Leaves as Fodder : *Aegle marmelos* (Bel) leaves.

N. D. KEHAR, M. M. JAYAL and K. SAHAI, Izatnagar, U.P.

Bel is a medium sized deciduous tree which grows wild in the Sub-Himalayan tract and Central and South India.

The percentage composition of leaves, on dry basis, was found to be; crude protein, 15.13; ether extract, 1.54; crude fibre, 16.45; nitrogen free extract, 52.83; total carbohydrates, 69.28; ash, 14.05; calcium (CaO), 5.93 and Phosphorus (P_2O_5), 0.69.

To determine the nutritive value feeding experiment was carried out on five adult male sheep. *Bel* leaves formed the sole feed. The animals consumed the leaves with relish. The average dry matter consumption worked out at 3.92 lb. of *bel* leaves per 100 lb. body weight per day.

The experimental animals, on an average, showed the following digestibility coefficients for the different constituents of the leaves: crude protein, 71.09; ether extract, 62.20; crude fibre, 30.23; and nitrogen free extract, 73.37. The digestible crude protein, total digestible nutrients and starch equivalent values in lb. per 100 lb. of the leaves on dry basis, were found to be 10.76, 56.65 and 46.13 respectively. The nutritive ratio works out at 1:4.26.

The experimental sheep recorded positive balances for nitrogen, calcium and phosphorus.

The above observations tend to show that *bel* leaves are quite palatable and nutritious and can meet the maintenance requirements of sheep.

50D. Digestibility and nutritive value of para grass (*Brachiaria mutica* Stapf) with a note on the effect of curing.

N. D. KEHAR, S. S. NEGI and D. N. KHURDY.

Green para grass has been evaluated by feeding it as the sole feed to non-pregnant dry buffalo cows at the Aarey Milk Colony, Bombay.

The average composition of green para grass on dry matter basis was as follows: Crude protein 7.28, ether extract 1.04, crude fibre 30.76, nitrogen-free-extract 48.34, total ash 12.58, calcium 0.57 and phosphorus 0.30. The metabolic trial was carried out only after the dry matter consumption of the animals was stabilised. During the period of the trial, the dry matter consumption of the animals averaged 2.13 lb. per 100 lb. body weight indicating that the grass was quite palatable.

The digestibility coefficients of the different nutrients in the green grass were found to be : crude protein 64, and the digestible nutrients in lb. per 100 lb. of dry matter were calculated to be : Digestible Crude Protein 4.66, Starch Equivalent 37.98 and Total Digestible Nutrients 56.25. The animals showed positive balances with regard to nitrogen, calcium and phosphorus.

Earlier the para grass cured at Bombay was evaluated as hay at Izatnagar on buffalo bullocks both as a sole feed and by supplementation with a calculated quantity of rape cake. The percentage composition of hay on dry matter basis was : crude protein 9.60, ether extract 2.00, crude fibre 34.95, nitrogen-free-extract 41.85, total ash 11.60, calcium 0.365 and phosphorus 0.155.

The average values for the percentage digestibilities of crude protein, ether extract, crude fibre and nitrogen-free-extract were obtained as 29, 73, 62 and 45 respectively and the Digestible Crude protein, Starch Equivalent and Total Digestible Nutrients values in lb. per 100 lb. of dry material were 2.78, 25.84 and 46.57 respectively. The hay appeared quite normal apparently but the low digestibility of crude protein in the hay compared to that in the green grass indicated that, presumably, the hay was not properly cured.

PLANT BREEDING, GENETICS AND CYTOGENETICS

51. Description of the Variant Forms of "Patol" (*Trichosanthes dioica* Roxb).

B. S. VERMA and S. K. MUKHERJEE, Krishnagar.

Patol (in Bengali) or Parwal (in Hindi) belonging to *Trichosanthes dioica* Roxb, of the family Cucurbitaceae is an important summer vegetable of West Bengal. Although it is one of the best summer vegetables it is not so well known in other parts of India. There are a number of types grown, which can be distinguished from one another on the basis of fruit characters, mainly size, shape, colour and markings on the skin. Five types have been described in the paper.

52. The Origin of the Early European Potato—Evidence from Indian Varieties.

M. S. SWAMINATHAN, New Delhi.

Potatoes could have been introduced into Europe from either the Chiloe region of South Chile (40° to 45° S latitude) or the Andes at tropical latitudes. Dr. S. M. Bukasov and other Russian workers have suggested that the Chiloe region was the place from which the original introductions were made since the Chiloe potatoes are morphologically similar to the varieties of *Solanum tuberosum sensu stricto* and also are adapted to long days. In contrast, the potatoes from the region of the Andes are typical short-day plants and have many semi-wild morphological characters. On the strength of this reasoning, the Russian workers have recognised two distinct tetraploid (2n=48) cultivated species, *S. tuberosum* and *S. andigenum* and postulated that these two have had independent origins. This view has been proved to be incorrect by the late Dr. R. N. Salaman who has published extensive historical and morphological data to establish that the original introductions to Europe came from Columbia, Ecuador or Bolivia. Dr. Salaman's work clearly suggests that the domestic potato of Europe, though given the name of *S. tuberosum* is in fact a variety of the species *S. andigenum* and has acquired its present range of characteristic forms of leaf and habit as a result of prolonged selection for higher cropping and early or late maturity. This conclusion is supported by the cytogenetic studies carried out by the writer in this material.

Though little is known about the history of the introduction and spread of the potato in India, it appears that the potato was brought into India from

Europe early in the seventeenth century. A detailed study of the potato varieties occurring in India by Dr. B. P. Pal and Dr. Pushkarnath has shown the existence of 16 distinct *desi* varieties besides many foreign named varieties in the country. Results from studies on leaf index and other morphological characters in the *desi* varieties Phulwa, Gola, and Darjeeling Red Round and cytological studies in Phulwa suggest that these varieties may have undergone few genetic changes, at least with reference to commercial characteristics, since the time they were first introduced. Hence the fact that the *desi* varieties have, like *S. andigenum*, an open habit, a low leaf index, long stolons, deep eyes in tuber and a day-neutral or short-day photoperiodic behaviour would further support the view of Dr. Salman that the early European potato possessed such characters.

These results are of interest from the point of view of breeding potato varieties suitable for cultivation in the plains of India. In the European and North American commercial potato varieties, a gradual accumulation of the major genes and polygenes controlling yield and culinary characteristics has been brought about as a result of the conscious selection and planned hybridisation work done during the past three centuries. To evolve varieties which will give high yields under short-day conditions, it may be worthwhile attempting to induce mutations of the genes controlling photoperiodic behaviour in the best foreign varieties possessing some degree of resistance to the more common virus diseases, instead of merely trying to incorporate the factors governing yield potential into the *desi* varieties. There is evidence to suggest that the genes controlling photoperiodic reaction in the potato are relatively unstable and hence it may not be difficult to achieve this objective.

53. Effect of Virus Infection on Meiosis and Seed Fertility in Chilli.

M. S. SWAMINATHAN, New Delhi.

Infection with viruses causes various changes in the normal cytological processes of plants. A study of the effects of mosaic virus infection on micro- and mega-sporogenesis and seed fertility in Chilli showed the following features. (a) There are several abnormalities during meiosis in microsporocytes in infected plants like lagging chromosomes at first anaphase, unequal distribution of chromosomes at second metaphase and formation of monads, dyads and micronuclei at the sporad stage. (b) Many ovules in an ovary remained unfertilized due to the delayed development of the embryosac at the time of pollination. (c) The number of seeds per fruit in a diseased plant was only about half the number found in the healthy plants. Even though the effects of virus infection are observed in the course of gamete formation, the virus is not transmitted through the seed. Several views have been advanced to explain the prevention of seed transmission of viruses. The most important among them are: (a) Only gametes which are free from virus are functional; (b) the virus is unable to penetrate the seed embryo; and (c) Some virus-inhibiting substances are present in the seed. The results of the writer's study and the fact that some virus diseases, such as bean and lettuce mosaic viruses, are transmitted through seed do not support the first view. The presence of inhibitory substances in the seed is considered to be the most probable cause of the non-transference of viruses through seed.

54. "Breeding of Mango" (*Mangifera indica* L.).

R. S. ROY and R. P. SINHA, Sabour.

Planned breeding programme was started at Sabour in 1941-42 with ten varieties of commercial and quality mangoes namely *Bombai*, *Langra*, *Fazli*, *Gulab-khas*, *Kailiki*, *Kalapady*, *Baramasia*, *Alfanse*, *Amandeshari* and *Sepia*.

In the study of floral biology it was observed that inflorescence is an irregular raceme having staminate and bisexual flowers, the former being more in abundance than the latter. Maximum anther bursting was found between 9 and 12 a.m. and pollen viability was the highest between 8 to 10 a.m. Bees and flies are the usual visitors for pollination in mango flowers.

Hybridization was done with 29 combinations of the varieties mentioned and 8737 flowers were pollinated out of which 19 hybrids plants are surviving upto-date. Four of the hybrid plants namely (1) Bombai \times Kalapady-2, (2) Langra \times Kalapady-1, (3) Kaitiki \times Langra-1, (4) Sunderprasad \times Langra-1. Two hybrids of Bombai \times Kalapady have come out with ideal characteristics. They have been named *Mahmud Bahar* and *Probha-Shanker*. The former has proved to be a regular bearer with good keeping quality and flavour of fruits with medium maturity. The tree is partially dwarf and bushy like Kalapady.

55. Variations in Cashewnut (*Anacardium occidentale* Linn).

DR. S. K. MUKHERJEE, Krishnagar, Nadia.

Cashewnut belonging to the species *Anacardium occidentale* L. under the family Anacardiaceae is exotic in India and has been introduced from S. America. It is now grown mainly along the coastal areas of Bombay, Madras, Andhra, Orissa and West Bengal. In West Bengal it is grown mainly in the district of Midnapur, where it covers about 2000 acres. While undertaking a survey of the Cashewnut area in the state it has been observed that there is a great range of variation in the types that are grown. As previous observations on this important dollar earning plant has not been adequately made in India, the present findings are recorded.

It has been observed during a survey of the Cashewnut areas in West Bengal that there are 6 different forms of the plant growing in the area, which have been described in the paper. These differ from one another mainly in the shape, size and colour of the fleshy thalamus (Cashew apple) and in the size of the nuts. The Cashew Apples are mainly of two colours—(1) reddish or (2) golden yellow. There is variation in the bearing behaviour of the plants, ranging from 15 lbs. of nuts per plant to about 80 lbs. per plant.

As the Govt. of India is now making a drive for expansion of Cashewnut cultivation and the Forest Deptts. are introducing the crop in the plantations, it is desirable that proper selection of mother plants is made for seed-nut collection, to reduce the variability in the progeny and to improve the crop.

56. Studies on Seed-raising of Cabbage (*Brassica oleracea* L. Var. *capitata* L.).

S. S. CHATTERJEE AND S. K. MUKHERJEE, Krishnagar, Nadia.

Cabbage is an important winter Vegetable in West Bengal and covers a good amount of the area. It is cultivated mostly from imported seeds, because seed raising is reported to be difficult under West Bengal conditions.

Investigations have been undertaken to find out the proper technique for raising cabbage seeds under West Bengal conditions and the work has been conducted in the Eastern Himalayas at the State Agricultural Farm, Kalimpong at an altitude of 4,000 ft.

The following inferences are drawn from the above work.

- (1) September transplanting gave better seed formation than October and November transplanting. November transplanting did not produce flowers.
- (2) English Ball behaves much better in seed production under Kalimpong conditions than Eclipse Drumhead.

- (3) Time of flowering does not vary proportionately to the time of transplanting.
- (4) The flowering period of each variety continues for about a month and it takes about two months for the seed to be matured for harvesting from the date of flowering.
- (5) The method of including flower stalks to sprout by making deep incisions on the head did not prove successful.
- (6) There has not been much difference in seed production between the methods, stumps kept insitu and stumps transplanted. Hence the former method is more profitable.

57. Studies on the *Cercospora* Leaf-Spot disease in the rooted leaves of *Dolichos lablab* L.

B. PADHI, Cuttack.

The leaf spot disease of *Dolichos lablab* L. caused by *Cercospora delichi* Ell. and Ev. is wide spread throughout Orissa and causes severe damage to the crop. The present paper records preliminary studies on the disease. Isolated rooted leaf cultures have been used all through to ensure economy of space and material and ease and exactness of experiments performed. Roots were induced on the petioles of the leave by the application of 5p p.m. aqueous solutions of β -Indolyl Butyric acid. The leaves were kept in propagating chambers with their petioles dipped into tap water or nutrient solution in test tubes with or without sand.

The spores of the fungus required very high humidity for germination. Symptoms were recognizable in about 5 days time but became conspicuous in 10 days time. Leaves kept in nutrient solution took longer time to show less amount of symptoms than those kept in water. Attempts to determine the path of penetrations were unsuccessful. A weak Bordeaux mixture shows promise of control.

58. Inhibition of Potato Virus X.

D. C. SHARMA and S. P. RAYCHAUDHURI, New Delhi.

A severe Ring-spot strain of potato virus X appeared on Potato plants variety *Gola* in the experimental plots of the Agronomy Division, at the Indian Agricultural Research Institute. The host-range and properties of the virus were studied in order to establish its identity.

Among the plant extracts tested for their inhibitory effects on the virus, chilli was found to be more effective than spinach and strawberry. Extracts of chilli when mixed equally with infective virus extract for 5 minutes before inoculation indicated average percentage inhibition of the extent of 90.5%, 69.5% and 60% for chilli, spinach and strawberry respectively. When the extracts were sprayed on leaf surfaces half-an-hour before inoculation, the average percentage inhibition was 76.5%, 41% and 29% for chilli, spinach and strawberry, respectively. The extract of chilli was capable of inhibiting infection with the virus even though it came in contact with the virus only after both entered the cells of the host. The inhibitory properties of chilli extract were retained after heating, dialysing and also absorption with activated Kaolin.

Growth products of *Aspergillus niger* obtained from three different media, were capable of inhibiting to varying extents infection with potato virus X, when mixed or sprayed before inoculation. The filtrate obtained from one of the three media tested was more effective and indicated average inhibition to the extent of 35.5% and 71% when it was mixed for 5 minutes or sprayed half-an-hour before

inoculation. The sprayed leaves remain refractory to infection for about 30 minutes and were as susceptible as untreated leaves when inoculations were made after 72 hours. The filtrate, however, failed to inhibit viral multiplication in previously inoculated leaves when spraying was done after 72 hours. Inoculation of upper surface of leaves and spraying of lower surface gave about some percentage inhibition as inoculation of the lower surface of the leaves and spraying of upper surface.

Thiouracil (2-mercap to-4-hydroxy pyrimidine) at the concentration of 500 mg/1 of above inhibited the viral multiplication by 100%. Inoculated potato plants var. Arran-victory were cured when supplied with thiouracil at the rate of 25 cc. per plant, per day at the concentration of 125 mg/1 for 7 days followed after inoculation.

Irradiation of test plants to ultra-violet light before and after inoculation indicated that percentage of inactivation increased with increased rates of exposure. Exposure of test plants to 5 minutes (6.6 m.u.d.), 10 minutes (13.3 m.u.d.) and 15 minutes (20.0 m.u.d.) immediately after inoculation indicated 60.5%, 71% and 86.5% inhibition in the infectivity of the virus, while irradiation 7 days after inoculation gave 23%, 33% and 49% inhibition respectively. However, exposure immediately and 7 days before inoculation did not inhibit the virus indicating thereby that the ultra-violet irradiation directly affects the viral particles rather than altering the host-susceptibility.

59. Mode of Infection and Reappearance of Tumour Disease of Coriander.

H. C. SRIVASTAVA, Mysore.

The penetration of the parasite and its location in the tissues of the host, was found out through a series of transverse sections cut from the seedlings of different ages (including pre-emerged plumule), sown in inoculated beds, and were examined in a basipetal succession. It was found that the intra-cellular rudimentary mycelium is present throughout the seedling upto one week and thereafter the mycelium could be traced only in the top portions while the formation of chlamydospores started in lower portion. Even one day old seedling or pre-emerged plumule also exhibited the mycelium. Observations show, that the fungus gets entry in the plant through seeds or through soil when the seed is just germinated and plumule is not emerged. In no case 5 days to 12 week old healthy seedlings were found infected, when transferred to heavily inoculated beds. Injuries and infection showed localized infection. The frequency of the disease was found increasing after once the disease appeared in the field. The chlamydospores shed to the ground during harvest, produce the disease in the crop sown in next season, after completing the dormancy.

60. Effect of Environmental Factors on Incidence of Damping-off.

H. C. SRIVASTAVA, Mysore.

The effect of soil temperature, moisture and reaction on pre- and post-emergence damping-off was studied in detail for *Lycopersicon esculentum* (tomato), *Impatiens balsamina* (balsam) and *Brassica oleracea* var. caulorapa (cabbage). Maximum pre-emergence damage was recorded, when the soil temperature and moisture was 28-31°C and 92-95% for tomatoes, 27-32°C and 90-92% for balsam, and 30-32°C and 92-94% for cabbage. Maximum post-emergence loss was recorded, when the soil temperature and moisture was 26-27°C and 90-95% for tomatoes, 25-31°C and

90-92% for balsam, and 23-31°C and 78-95% for cabbage. In cabbage, when the infection was by *Rhizoctonia solani* alone, there the maximum post-emergence damage was recorded at 30-31°C and 78-82% of moisture. Pre- and post-emergence damping-off in tomato, balsam and cabbage was maximum when the soil pH was 5.6 to 7.2 in *Pythium* and *Rhizoctonia* inoculated pots. It was noted that in the case of *Pythium* the damage was less in acidic soil, while in case of *Rhizoctonia* it was comparatively more.

61. Effects of Cross Inoculation on Gram.

H. N. MUKHERJEE, K. K. JHA and A. S. VERMA.

Gram (*Cicer arietinum*) is the most common leguminous crop of Bihar. Experiments on inoculation of gram with root nodule bacteria have, therefore, been taken up in different parts of Bihar with an object of improving the stand of the crop and thus also help in building up soil fertility. With the exception of some places, no encouraging results of inoculation of gram with its own root nodule organisms have been obtained.

In course of studies on inoculation some indications of increase in growth of gram on cross inoculation with nodule organisms came up. To test these observations further, pot experiments under controlled conditions on cross inoculation of gram with root nodule organisms of Pea group (to which gram plant was known to belong earlier, now it is considered a cross inoculation group by itself) and lucern were conducted for two years. The results obtained, show that cross inoculation of gram seed with the root nodule organisms of lucern increased significantly the weight of plants at 1% level. Gross inoculation of gram with lucern organisms thus offers a strong possibility of improving the stand of gram crop in Bihar.

The efficacy and usefulness of the concept of 'cross inoculation groups' has already been challenged by many workers and the findings here may further strengthen their stand. It is, however, contemplated to continue these experiments further in pots and fields and side by side undertake necessary laboratory investigations on nodulation and nitrogen fixation as a result of these cross inoculation studies in view of their theoretical and practical importance.

62. *Alternaria* Leaf Spot of Wheat in Uttar Pradesh.

R. S. MATHUR, Kanpur.

During the rabi season of 1954-55, wheat cultures at the Government Research Farm, Kanpur were severely affected by leaf spots. The spots were elongate, yellowish brown and later became dirty brown with a greyish centre. The severely affected leaves dried up. The spots were caused by *Alternaria* sp. which was isolated in pure culture for inoculating healthy plants. Typical symptoms were produced on the fifth day of inoculation. Naturally infected material showed spores of the 'long cone' type and size $18.6-57.2\mu \times 7.2-14.3\mu$. The spores tapered gradually into a beak and had few longitudinal septae. One month old cultures on 2 per cent potato dextrose agar showed spores of the same shape but smaller size— $14.4-21.5\mu \times 4.3-8.7\mu$. The morphology of the fungus agreed closely with *Alternaria tenuis* and of the group '*Longicatenatae*'.

Wheat strains N.P. 710, A.O. 88, I.W. 115-C and NP 125 were moderately affected whereas *Triticum pyramidale*, I.W. 7-2 and Jaya wheats were most severely affected.

63. The Effect of Temperature and Humidity on the Development and Distribution of Sugarcane Stem Borer, *Chilo traea infuscatellus* (Snellen) (Crambidae—Lepidoptera).

S. PRADHAN and S. K. BHATIA, New Delhi.

Investigations were carried out on the development of *Chilo traea infuscatellus* (Snellen) under different combinations of temperature (12, 20, 25, 30, 35 and 40°C.) and humidity (30, 60 and 90%) under laboratory conditions and on distribution of this species in India in relation to temperature and humidity conditions in different parts of the country; the following tentative conclusions have been arrived at:

(1) The larvae of *C. infuscatellus* enter into a physiological diapause during winter in Northern India and when some larvae collected in nature during that period were kept at constant temperatures of 25, 30, 35°C., most of them failed to regain normal activity and development.

(2) The duration of development of different stages decreases with the rise of temperature 12°C. and 40°C. appear to be very near the lower and upper limits for development of the eggs, larvae and pupae. Percentage viability is lowered at both the extremes of temperature.

(3) Best humidity for development of eggs and pupae is 90% at which highest number of individuals completed development under almost all temperature conditions studied. Lower humidity reduces the percentage viability of these stages.

(4) Study of distribution of the pest shows that temperature and humidity conditions do not act as limiting factors for the existence of this pest in any part of the year and in any part of India.

(5) The hibernation of larvae from October to February in North India is not due to unfavourable temperature but due to some other physiological factor.

64. Microbial Rot of Tapioca Tubers—Causes and Control.

S. K. MAJUMDER, S. V. PINGALE, M. SWAMINATHAN and
V. SUBRAHMANYAN, Mysore.

The spoilage noticed in tubers of tapioca on storage for a short period is reported to be caused by *Rhizopus* sp. and a *Basillus* sp. The changes brought about by the two organisms in the tubers are described and it is shown that *Rhizopus* sp. is responsible for discolouration under aerobic conditions and the bacterium for development of high acidity under anaerobic conditions. Fumigation of tubers within 48 hours of harvest with either ethylene dibromide or ethylene dibromide and ethyl bromide mixture or treatment with formaldehyde is observed to delay the spoilage. It is reported that the normal tubers store well for 4 days but the fumigated ones for 12-19 and formaldehyde treated for 25 days.

The treatments are evaluated on the basis of starch yield, development of acidity, and organoleptic tests. In the light of the findings it is considered that the treatments should help the industry in avoiding losses to fresh tubers during the periods of glut.

65. Anthracnose of Jute.

T. GHOSH, Barrackpore.

Anthracnose of jute (*Corchorus capsularis* L.) was reported from Japan in 1940. But the disease was unknown in India and Pakistan till 1950. In 1950 annual recurrence of epidemics caused by a species of *Collectotrichum* has been

observed in many varieties of *C. capsularis* exotic and indigenous, particularly in the former. The disease starts in the hot and humid days of June and is not severe in August. The pathogen is mainly seed-borne. The disease was also reported from Malaya. The author maintains that the proper naming of the fungus would be *Colletotrichum capsici* f. *corchorum*. The details will be published shortly.

66. Ratooning of Sea Island Cotton.

B. SEN and S. N. SRIVASTAVA, Almora.

Earlier experiments with both high and low temperature pre-treatment of seeds of Sea Island cotton gave negative results. Though short day treatment of seedlings induced earliness in flowering of about 2 weeks, its practical utility on the field scale was very meagre.

It was found in 1947 that properly irrigated Sea Island cotton plants can survive the winter even of this region. Experiments were undertaken to find out the best method for obtaining ratoon crop of Sea Island cotton. It was found that the cost of irrigation of cotton plants during the winter months can be justified by raising a crop of Garden pea, the only legume cash crop which will grow during winter months, between the rows of cotton.

The yield from the first year crop of Sea Island was 499 lbs. of Kapas per acre, in 1951. In 1952 the yield of Kapas from the ratoon crop in the same plot calculated on acreage basis was 1500 lbs. and yield of Garden pea on acreage basis was 10.8 mds. of green pods and 11.3 mds. of only seeds.

The fibre length of new cotton was 1.26" and of ratoon cotton 1.24" and the spinning value (H.S.W.C.) was 66 and 64 respectively. Large scale ratooning of Sea Island cotton may be done to advantage, provided one takes a crop of Garden pea from the same plot in winter.

These results have been verified in trials conducted in this Laboratory in subsequent years.

Expenses of 1952-53 period were met from a grant of I.C.C.C., Bombay.

67. Plant Physiology as Applied to Plant Breeding and Genetics II : Adjustment of Flowering Time by Sowing Dates.

D. K. MUKHERJI, Calcutta.

The hexaploid synthetic species, *Triticum timococcum*, flowers very late when sown in October, the normal wheat sowing time. This is one of the reasons why this species, having very desirable disease-resistant qualities, cannot be used for crossing with the cultivated wheat varieties. In an attempt to get it flowered in time with the cultivated varieties of wheat, a series of sowings under normal field conditions as well as under glasshouse (higher temperature) was made beginning from the middle of August till early January. It was observed that while all the plants grown under glasshouse conditions between such a wide range of 4½ months flowered within a short range of about 3 weeks and that the vegetative period steadily decreased from 294 to 158 days, those grown under normal field conditions did not flower in time excepting the mid-August sowings. The low temperature during the early growth period may adversely affect the flowering in this particular species when it is sown in September or October. When the influence of the low temperature is absent (as when the plants are grown under glasshouse), the plants however flower in normal time. The flowering behaviour of the mid-August-sown plants under normal field conditions may be explained in

this way that the temperature in the early growth period of the plants (in August and early September) is not so low as to affect the flowering of the plants. Thus, it was observed that in order to get this species flower in time along with the cultivated wheat varieties, it should be sown in mid-August instead of in October under the normal field conditions, and at any time between August and January under glasshouse conditions.

68. Studies on Photo Periodism in *Phaseolus radiatus* and *Phaseolus actinofolius*.

G. V. CHALAM and S. S. MISRA.

Two varieties of *Phaseolus radiatus* (Utkal No. 1 and Utkal No. 2) were subjected to short day treatments of different duration at different ages both in the Khariff and rabi seasons. In the short day treatment the dark period was 16 hours a day both in the Khariff and rabi seasons. In the case of *Phaseolus actinofolius* the short day treatment was given in the Khariff season only.

In *Phaseolus radiatus* the treatment was given for 7, 14, 21 days at 16 hours dark period at the age groups of 1, 10, 20, 30 days. In both the varieties there was response to 16 hours dark period at the age of 20 days only when treated for 14 days and 21 days. In the case of Utkal No. 1 the treated flowered earlier by 10 and 11 days respectively than the control, while in No. 2 the treated flowered 5 days earlier than the control.

In the Kharif season also the same treatments were repeated the response came at the age of 7 days when the treatment was given for 14 days with dark period of 16 hours per day. The difference between the treated and control was five days only.

In the case of *Phaseolus actinofolius* the control did not flower at all in the Khariff season while the treated flowered by 29 and 37 days respectively under the above treatments.

Utkal No. I and II flower in 32 days and 31 days respectively in Khariff and by 49 and 42 days in Rabi season.

69. On Control of Fungal Spoilage of Fruits in Cold Storage.

H. C. SRIVASTAVA and P. B. MATHUR, Mysore.

Fruits can be well preserved in cold storage to fetch good premiums, but in certain cases excessive spoilage may become a limiting factor to it. Twenty-two micro-organisms were isolated from the cold storage chambers at this Institute and the various fruits stored therein. Subsequently, the efficacies of 2% formalin, 5% "Lysol" solution, and 1% iodine solution as fungicides for spraying the cold storage rooms were tested.

The following conclusions have been arrived at: (1) the two chambers maintained at the lowest temperatures, viz., 32-35°F and 35-38°F were relatively free from micro-organisms, (2) spraying of cold storage chambers with a 5% "Lysol" solution or 2% formalin before storing the fruits would be helpful in reducing the spoilage during cold storage.

70. Studies in the Deep-fat Frying of Cashew Kernels.

M. PRASAD and P. B. MATHUR, Mysore.

A study of the factors involved in the deep-fat frying of cashew kernels has been made. A temperature of 160°C and a duration of 80 seconds have been found

to be the optimum conditions for the deep-fat frying of cashew kernels. The percentages of moisture lost during frying of cashew kernels increased with increasing durations of frying. On the other hand, the percentages of gain in weight of kernels at the end of frying operations decreased with increasing durations of frying. As a result of these opposing tendencies, the oil-uptake tended to be the same at all the frying temperatures and with respect to all the durations of frying investigated.

It was found that the moisture loss from the kernels is greater if the proportion of kernels with respect to a given quantity of oil is reduced. On the other hand, the oil-uptake by the kernels increased when the proportion of kernels with respect to a given quantity of oil was reduced.

The deterioration is far greater in the case of peanut oil as compared to "Vanaspati" during the frying of cashew kernels.

71. Refrigerated Gas Storage of Cavendish Bananas.

*N. S. KAPUR and E. G. HALL, Sydney.

Following successful trials of gas storage of Gros Michel bananas in Cambridge in 1953, an attempt has been made to study the effect of gas mixtures on the storage life of Cavendish bananas. In this case besides producing the Gas mixture by restricted ventilation an attempt has been made to use low oxygen (5%) and 0% or 5% CO₂, balance N₂ the attempt is also made to remove the volatiles by alkaline KMnO₄. Useful results are obtained. Of all the mixtures tried 5% CO₂ + 5% O₂ was found to prolong the storage life to the maximum extent. Volatiles are found to interfere and produce less natural flavour. Using this mixture and removing the volatiles, by scrubbing the gases through alkaline solution of potassium permanganate, it is possible to produce a fair increase in the storage life of bananas.

72. Waxing of Bananas.

*N. S. KAPUR and E. G. HALL, Sydney.

Following successful storage of bananas by waxing in Queensland it was decided to try the same on a more scientific basis. It seemed that coatings retarded ripening to a fairly large extent. It also retarded shrinkage. All the coated fruits ripened satisfactorily at 68°F and room temperature (75°F). The effect of waxing was not very significant at low temperature as it retarded the ripening of pulp more than that of the skin resulting in the development of latent infection of *Colletotrichum* on the skin.

Of all the mixtures of waxes tried it is found that for commercial use Ceremul A+M (3:1) 8% or C+M 8% would be adequate and could be of definite value, the A+M mixture gave a better looking coating. Stability of these emulsions, particularly Ceremul C₁ could be improved.

73. Effect of Skin Coatings on the Storage Behaviour of Mangoes.

P. B. MATHUR and H. C. SRIVASTAVA, Mysore.

The effect of two skin coatings, viz., a wax emulsion in water and a refined mineral oil on the storage behaviour at room temperature (73-82°F, R.H. 65-90%)

*N. S. Kapur was on deputation to Australia from Central Food Technological Research Institute, Mysore.

of 3 varieties of mango—Padre, Neelam and Totapuri—has been studied. Treatments with wax emulsion as well as refined mineral oil resulted in reducing the physiological losses in weight as well as the respiration rates as compared to the controls.

With a coating of wax emulsion in water, increase in storage lives at room temperature (73-82°F; R.H. 65-90%) of the order of about 50% were obtained in all the varieties investigated. Applications of refined mineral oil only to the top one-third of the mangoes resulted in increasing the storage lives by over 50%.

74. Studies in the Cold Storage of Peanuts.

P. B. MATHUR, M. PRASAD* and KIRPAL SINGH, Mysore.

Peanut is one of the most important oil-seed crops of the world. In 1954 the commercial crop of the world was estimated at 12 million short tons.

Shelled and unshelled peanuts packed in small gunny bags were stored at 4 temperature ranges, viz., 32-35°F, 42-45°F, 52-55°F and room temperature (71-92°F) for 9 months. The relative humidities ranged between 85-90% in the cold storage chambers and 50-82% at the room temperature.

A great deal of parallelism was observed between the changes in the moisture contents of the kernels and the changes in peroxide and acid values of the extrated oils during storage. A free fatty acid content exceeding 1% was found to be associated with seeds of low germination capacity.

As a result of this investigation a temperature of 32-35°F and a R.H. of 85-90% are recommended as the optimum conditions for the cold storage of shelled peanuts. The approximate cold storage life is 9 months.

75. A Comparative Study of the Effects of Short Day on Summer and Winter Varieties of Rice.

P. K. SEN and G. N. MITRA, Calcutta.

Effects of exposure to short days (eight-hour day length) for varying periods namely, (i) 2 weeks, (ii) 4 weeks and (iii) continuously till flowering, starting at different stages of growth namely, (i) from time of germination, (ii) from 2 weeks after germination and (iii) from 4 weeks after germination with and without a previous exposure to short days for the first 2 weeks, on tillering, height, leaf number and flowering in summer (*Aus*) and winter (*Aman*) varieties of rice have been investigated.

Irrespective of varieties short day has shown an optimum effect on vegetative growth as indicated by tillering and height inasmuch as exposure to short days for 2 weeks has increased them while longer exposure has reduced them. It is further indicated that the later is the stage of development of the plants at which short day treatment is given the lesser is the intensity of its effect.

Although short day shows similar effects on vegetative growth in both the summer and winter varieties of rice, its effects on flowering are different. Short day accelerates flowering in the winter rice but retards the process in the summer variety, the rates of acceleration and retardation indicating a direct relation to the length of the period of exposure to short days.

76. Preliminary Report on Some Physiological Peculiarities of Citrus Species, Regarding Trace Element Requirement.

S. K. MUKHERJEE and K. K. BANERJEE, Krishnagar.

Small mottled leaves and characteristic leaf chlorosis patterns were observed in the Orange block of the Horticultural Research Station, Krishnagar, containing

Sweet Oranges (*Citrus sinensis* Osbeck) of the types Mosambi, Sathgudi, Valencia and Pineapple, and Mandarin Oranges (*C. reticulata* Blanco) of the types Nagpur and Coorg Santras and Khasi (Assam) Oranges, during last February; the latter group however did not show any apparent symptoms. A spray of Zinc Sulphate and hydrated lime solution was immediately given to 4 rows of plants keeping 2 intermediate rows as control. The symptoms were greatly reduced in the treated plants whereas in the controls these were aggravated.

It is interesting to note in this connection that under Krishnagar conditions, the Mandarin Oranges, the Pummelos (*C. maxima* Merrill) and the Lemons (*C. limonia* Osbeck), did not show any appreciable deficiency symptoms, although growing in the same and adjoining plots with the Sweet Oranges. It appears therefore that the Mandarin or loose jacket oranges have better physiological aptitude to meet their trace element requirements in comparison to the Sweet Oranges, at least under Krishnagar conditions. This observation deserves verification from other Orange growing areas of India.

77. Studies on Grain Storage—I Population Dynamics of *Trogoderma Granaria* in Wheat Stored in Earthen Bins and Jute Bags.

S. V. PINGALE and P. J. DEORAS, Bombay.

The growth of *Trogoderma granaria* (Everts) populations observed in wheat stored in earthen bins and jute bags and the changes in temperature, moisture and viability associated with it are reported. It is shown that in earthen bins or jute bags that were not disturbed, initial heavier infestations resulted in less spoilage, to the grain. This is explained on the basis of heat generated and moisture lost from the grain as a result of the infestation. The practice of adding *T. granaria* larvae to the grain prevalent in Bombay State is therefore considered advantageous and suitable to storage in earthen structures.

It is concluded that though the addition of insects to the grain may not appeal today the advantages offered by a receptacle that is a bad conductor of heat and sorptive to the moisture, as brought out in the experiments, are of great practical importance.

SECTION OF PHYSIOLOGY

President :—DR. D. V. S. REDDY, M.B.B.S., M.Sc.,

Abstract

BLOOD

SUMMARY

1. A study of Prothrombin Time in Cholera.

DR. H. N. CHATTERJEE, DR. S. M. GHOSH, LT.-COL. K. K. CHATTERJI, DR. B. B. CHATTERJEE, DR. H. K. CHAKRAVARTY, and DR. N. R. RAY.

1. Forty one cases of Cholera were examined for Prothrombin time before administration of Saline as well as after treatment.

2. A definite decrease of Prothrombin time was observed which tended to become normal during convalescence.

3. In some cases even after restoration of the blood specific gravity, the Prothrombin time remained low. These were clinically severe cases.

4. The importance of the study of Prothrombin time and its relation to the various thrombotic phenomena that occur in Cholera are discussed.

5. In all cases of Cholera superimposed on pregnancy, as well as in some cases of normal pregnancy, the Prothrombin time was found reduced. In Cholera cases this seems to be not an unmixed evil as there is a greatly reduced post-partum haemorrhage which seldom extends beyond the first day.

2. Effect of Metallic Ions in the Coagulation Process of Blood.

N. K. SARKAR, B. B. NATH and K. L. MUKHERJEE, Calcutta.

Cations in general have been found to play significant roles on the coagulation of blood e.g. Ca^{++} has been found to be essential in the transformation of prothrombin to thrombin by tissue thromboplastins and not by Russell's viper venom and trypsin. Metallic ions such as Ca^{++} , Zn^{++} , Pb^{++} , Hg^{++} , Ni^{+++} , Co^{+++} etc. have been found to inhibit the clotting process when used above a certain critical concentration. Their inhibitory effects could be counteracted by adding an excess of Ca^{++} ions. It has also been noted that above 0.05 M concentration these ions irreversibly block the coagulation of blood; even addition of thrombin, at this stage, could not produce coagulation. These ions when used at a concentration below 0.005 M could not altogether prevent the clotting of blood but the clotting time is very much reduced by their presence. Curiously enough these ions at this concentration level accelerate the rate of formation of fibrin from fibrinogen. Anions, on the contrary, do not have any effect on the clotting process. A discussion relating to the mode of actions of these ions have been presented.

3. Observations on Normal Prothrombine Time and the Thromboplastic Activity of the Amniotic Fluid.

R. K. DAS and J. M. SENAPATI, Cuttack.

The normal prothrombine time was estimated in 100 apparently healthy individuals of the age group 20 to 30 years by the method of Quick as modified by

Magath using Russel's viper venom (Messrs. Nandy & Co., Calcutta). The range was from 18.2 sec. to 24 sec. with a mean of 21.1 sec.

Fresh amniotic fluid was used as the thromboplastic material, and the prothrombine time was found to be 43.4 sec. in average. Amniotic fluid loses its potency very soon outside the body.

4. Studies in Intra Organ distribution of blood (in the Kidney) by the Labelled Red Cell Technique.

S. R. MUKHERJEE, Calcutta.

When erythrocytes labelled with radioactive phosphorus (P^{32}) are injected intravenously, they soon mix completely in the circulating blood. Once mixing is complete, the presence or absence of radioactivity in any tissue may be taken as a criterion of whether the blood was flowing through the particular tissue. If the radioactivity of different portions (A and B) of the same tissue is measured separately, the relative distribution of the amount of blood in each portion can be calculated by the formula

$$\frac{\text{Radioactivity of A}}{\text{Radioactivity of B}} = \frac{\text{Amount of blood in A}}{\text{Amount of blood in B}}$$

By this principle, intrarenal distribution of blood (in cortex) was studied in normal rabbits and rabbits after the application of tourniquets to both hind limbs and no significant difference in the patterns was obtained. In both the series, individual variations were observed in which either the peripheral or the deeper part of cortex contained more blood than the other.

5. Blood Composition of Growing Animals in Humid Climate.

N. D. KEHAR and D. C. SHARMA, Izatnagar, U.P.

The importance of the normal blood composition of animals in nutritional and physiological research has been emphasised by Sen and Roy 1938, Kehar 1940 and Kehar *et al* (1940, 1945, 1951a, 1951b). Since the factors likely to cause variations in blood from normal range may be food breed or climate, an attempt was made to investigate the effect of higher temperature and humidity on the normal blood composition of growing calves of two different breeds.

16 Haryana heifers and 16 Bengal heifers were divided into two groups; one group of both the breeds was receiving rations imported from Punjab and the other one on Bengal diet at Calcutta. Another group of eight Haryana heifers was maintained at Hissar on Punjab diet.

Blood serum was analysed quarterly for protein, non-protein nitrogens, calcium and inorganic phosphorus of the animals at Calcutta and Hissar. The results showed that Haryana heifers at Hissar had higher values practically in all the constituents in comparison to Haryana heifers maintained at Calcutta. The figure for Haryana heifers at Calcutta are intermediate between Haryana heifers at Hissar and Bengal heifers at Calcutta. Bengal heifers on both diets showed very little variations.

These observations, extending over a year, are still in progress.

HEART AND CIRCULATION

6. Amodiaquin (camoquin) in cardiac arrhythmias.

R. B. ARORA and B. R. MADAN, Jaipur.

Efficacy of chloroquine in experimental auricular fibrillation was reported in a previous communication from this laboratory. Since amodiaquin a closely related

chemical compound resembles chloroquine in exhibiting marked antimalarial activity as well as in possessing antiveratrinic and negative inotropic properties, it seemed worthwhile determining whether it too had an antiarrhythmic activity comparable to that of chloroquine or quinidine.

It was found that amodiaquin and quinidine, lengthen the refractory period of isolated rabbit auricles in equal proportions, but the former was stronger in bringing about reduction in the duration of acetylcholine-induced auricular fibrillation. Both these agents further showed a similarity of action in their effects on P-Q and Q-T intervals (indicative of conduction time and refractory period respectively). But amodiaquin differed from quinidine in not exerting any protective action on ventricular arrhythmias induced by adrenaline and hydrocarbon-adrenaline.

Since the doses required to be effective in experimental auricular fibrillation, were less than are reported to have been employed via Intravenous route in cases of malaria, therefore it is considered worthwhile to subject this drug to clinical trials.

7. Tridiurecaine a new local anaesthetic in experimentally induced atrial flutter, atrial fibrillation and ventricular arrhythmia.

R. B. ARORA, V. N. SHARMA and B. R. MADAN, Jaipur.

Tridiurecaine a new drug chemically related to procaine has been investigated in experimental cardiac arrhythmias and compared with quinidine.

Stable auricular flutter was produced by the injury-stimulating procedure and auricular fibrillation was induced by applying—(i) 5 per cent solution of acetylcholine and (ii) 0.05 per cent aconitine nitrate solution on the right auricle in pentobarbitalized dogs.

The effects on the refractory period was noted by the change in Q-T interval as well as by tests on isolated rabbit auricle. The effect on conduction rate was observed by the change in Q-T interval in the electrocardiogram of cats. The protective action of the drug was seen in hydrocarbon-adrenaline induced and digitalis induced ventricular arrhythmias.

Tridiurecaine and quinidine produced reversion of auricular flutter at 14 mg/Kg/min. intravenously. The intravenous toxicity in albino mice in 70 ± 3.5 mg/Kg of tridiurecaine and 56 mg/Kg for quinidine. It is hence more effective and less toxic than quinidine in auricular flutter.

It exhibited protective action on hydrocarbon-adrenaline induced ventricular arrhythmias in the same doses as quinidine.

The drug was however found inferior to quinidine in auricular fibrillation.

This drug in the opinion of the authors is promising and its clinical screening in auricular flutter and ventricular arrhythmias is recommended.

8. The response of Atrio-ventricular node to autonomic agents.

R. B. ARORA and P. K. DAS, Jaipur.

The automaticity of A-V node was studied in respect to its response to adrenaline, nor-adrenaline, acetylcholine and atropine and was compared to that of S-A node under the same experimental conditions. Experiments were conducted on 35 thoracotomised dogs with heart in situ, having S-A or A-V node responsible for the automaticity.

It was seen that the response of both the junctional tissues of heart to autonomic agents remains the same qualitatively but quantitatively there were significant differences.

Following atropinisation heart rate increased by 20 per cent in S-A nodal rhythm and 5.5 per cent only with A-V rhythm. It appears that vagal control on A-V node, though it is there, but is much less than that on S-A node.

Response of A-V node to cardio-accelerators was much less than that of S-A node. The diminished excitability of A-V node is probably due to initial low vagal tone.

Cardio-inhibitory action of acetylcholine was much more on A-V rhythm than on S-A rhythm. Besides the factor of low vagal control, it appears that A-V node is more susceptible to acetylcholine than S-A node, as has been seen previously also with barbiturates.

9. Variation of Electrical Axis of Human heart in Different body Postures.

D. P. SADHU, Calcutta.

While attempting to determine the E.C.G. of the Goats of Jamnapuri breed it was noted that the first or second lead was negative in these goats. It was thought that this might be related to the quadruped posture of these animals. Healthy students of the Bengal Veterinary College were subjected to quadruped and other body postures and the variation of their electrical axes determined. It has been noted that there is a considerable variation of the electrical axes in students in the different postures. This difference is however, not sufficient to explain the negativity of the E.C.G. leads in goats.

10. Effect of bleeding and subsequent injection of blood on Intestinal movements with carotid sinus mechanism in tact and after denervation.

SANJEEVA RAO, K. and REDDY, D. V. S., Madras.

Using the standard techniques for dissection and isolation of the carotid sinus, the following observations were made after withdrawal of varying quantities of blood and reinjecting the same.

First series of experiments were done with the *Right sinus nerve denervated and the left sinus nerve intact*.

(a) Withdrawal of 50 c.c. of blood—resulted in a fall of blood pressure and an increased in intestinal tone and movements. After 20 seconds, the blood pressure showed a rise, accompanied by a reduction in intestinal tone.

(b) Withdrawal of another 50 c.c. of blood—similar results as above.

(c) Withdrawal of 10 c.c. of blood—resulted in a steep fall of blood pressure and a rise in intestinal tone and movements.

(d) Withdrawal of 150 c.c. of blood—resulted in a profound fall in blood pressure; accompanied by a sudden and prolonged reduction in tone of intestines.

(e) Re-injecting the blood into the animal—resulted invariably in a gradual rise of blood pressure and an increase in intestinal tone and movements for a minute or two and followed by a fall in the tone and movements.

Second series of experiments were done with both sinus nerves cut.

(a) Withdrawal of 100 c.c. of blood—resulted in a steep fall of blood pressure and a reduction in intestinal tone.

(b) Re-injecting blood—resulted in a gradual rise of blood pressure, with not much appreciable change in intestinal movements.

These findings are of interest in connection with haemorrhage, after accidents and bleeding during operations; the loss of blood and the reduction of vol. of

blood may have reflex effects on intestinal tone and movements; similarly during transfusion or saline infusion, the increased volume may have reflex effects on intestinal movements. In subjects where the presso-receptors are hypersensitive or insensitive, the effects on the intestine may be unexpected.

11. The effect of previous or simultaneous administration of adrenaline, nor-adrenaline, and acetyl-choline on the reflex regulation of intestinal movements by the carotid sinus.

SANJEEVA RAO, K., Madras.

In continuation of our previous work on the reflex control of intestinal movements by the carotid sinus, the following experiments and results are presented.

1. Adrenaline (0.1 c.c. of 1 in 10,000 solution).

Increase of pressure in the carotid sinus reduces the reflex effects on intestinal movements. Reduction of pressure in sinus by clamping the common carotid artery enhances the effects. (There is a greater inhibitory effect on the intestines.)

2. Nor-adrenaline (0.1 c.c. of 1 in 10,000 solution).

Increase of pressure in the carotid sinus resulted in a preliminary inhibition of intestines followed by a quick recovery of tone and augmentation of tone. Decrease of pressure by clamping, induced a greater inhibition of tone and movements. Compared with adrenaline, the inhibitory effect of nor-adrenaline on the intestines was less.

3. Acetyl-choline : (0.25 c.c. of 1 in 10,000 solution).

Increase of pressure, or reduction of pressure by clamping, did not produce any appreciable modification of the usual reflex effects.

Variations in the autonomic balance appear to influence the intestinal responses mediated through the carotid sinus, the sympathetic nerves and the sympathomimetic drugs producing a greater effect in modifying reflexly the tone and movements of the intestines.

RESPIRATION

12. Role of afferent impulses from the upper respiratory passages on Respiration.

H. D. SINGH and D. V. S. REDDY, Madras.

The respiratory responses to stimulation of the upper respiratory passages were studied in dogs anaesthetised with chloralose. Ventilation costal and abdominal movements were recorded simultaneously.

Mechanical, electrical or chemical stimuli applied to the nasal mucosa causes acceleration of respiration with or sometimes without increase in ventilation. The response is abolished by desensitisation of the mucous membrane.

Mechanical stimulation of pharyngeal mucosa inhibits respiration. The response is abolished by section of both the glossopharyngeal nerves and pharyngeal branches of vagus, and not on section of either of them only. Faradic stimulation of the central ends of these nerves inhibits respiration. The afferent impulses travel along both glossopharyngeal nerves and the pharyngeal branches of the vagus.

Mechanical stimulation of the laryngeal mucosa inhibits respiration. The response can still be elicited after bilateral midcervical vagotomy, or section of the superior laryngeal nerves, but is abolished by section of both, or by section of vagi above the origin of the superior laryngeal nerves. Faradic stimulation of the

superior or inferior laryngeal nerves produces varying degrees of respiratory inhibition. The laryngeal afferent impulses pass along both superior and inferior laryngeal nerves.

13. Role of afferent impulses from the lower abdominal organs on Respiration.

H. D. SINGH, Madras.

Respiratory responses to stimulation of the lower abdominal organs were studied in dogs anaesthetised with chloralose. Ventilation, costal, and abdominal movements were recorded simultaneously.

Traction on the appendix and traction or distention of the ascending colon causes inhibition of respiration. The response is not completely abolished by transection of the spinal at the level of the 3rd thoracic spine, or by bilateral mid-cervical vagotomy, but is abolished after chordotomy and vagotomy.

Traction or distention of the descending colon inhibits respiration and the response is abolished by chordotomy.

Squeezing the urethral end of the bladder causes increase in respiratory rate and ventilation and the response is abolished by chordotomy.

The respiratory afferent impulses from the descending colon and urinary bladder travel up the spinal cord, while those from the appendix and ascending colon travel up the spinal cord as well as the vagi.

14. Auriculo-Respiratory Reflex.

H. D. SINGH and D. V. S. REDDY, Madras.

In dogs anaesthetised with chloralose, pull upon the pinna of the ear or clamping the pinna with artery forceps, produced increase in rate and depth of respiration. Stretching or clamping the skin over the trunk or limbs did not produce any change in respiration. Infiltration of the base of the pinna with procaine hydrochloride abolished the response.

ENDOCRINES

15. Studies on the functional activity of the adrenal cortex in some infectious diseases.

BIJAYKUMAR CHAKRABARTI and SACHCHIDANANDA BANERJEE, Calcutta.

Eosinopenic response 4 hours after the injection of epinephrine was studied in 28 normal subjects, in 25 patients suffering from meningococcal meningitis, in 25 cases of tetanus, in 17 cases of tubercular meningitis, in 23 cases of typhoid fever and in 22 cases of pneumonia. While in normal subjects the mean fall in the circulating eosinophils was 59.8 per cent, the average eosinopenic response in other diseases varied between 25.6 and 35.4 per cent. Serum sodium and potassium and ascorbic acid content of the whole blood were estimated in normal persons and in patients suffering from various infectious diseases mentioned above. There was a significant decrease in the serum sodium values and blood ascorbic acid levels and an increase in the serum potassium contents in all the patients investigated. The above studies indicated hypoactivity of the adrenal cortex in those diseased conditions.

16. Role of Cortone Acetate in Producing Alloxan Diabetes in Young Rats.

ANUBHA CHOWDHURY and P. B. SEN, Calcutta.

Alloxan does not produce diabetes in very young rats when injected in a dose of 40 mg/kg. body weight.

When alloxan supplemented with cortone acetate is injected to young rats transitory diabetes and glycosuria for about 4 days are produced whereas no glycosuria is observed in rats injected either with cortical hormone or alloxan. In the latter two cases blood sugar level, however, is raised to a small extent.

Histological study shows that the beta cells of pancreas from the rats injected with alloxan and cortical hormone are in a more degenerated conditions as compared to such cells in pancreas of rats injected either with alloxan or cortical hormone.

17. 17-ketosteroid in urine and its significance.

M. L. CHAKRABARTY and ANIL CH. CHATTERJI, Calcutta.

In order to determine the development, persistence and decline of the sex urge in the male of different ages in the tropics, where puberty sets in early, an enquiry is being made into the sex activity. For this purpose quantitative estimation of 17-ketosteroid in the urine has been decided. In fact this is considered as the "Biochemical Index" of the testicular activity. In comparison with the published data, although very few, values obtained so far in our investigation show lowered figures. About 30 cases have so far been done comprising normal individuals of varying ages and people suffering from various abnormalities, e.g., development, hirsutism etc. The work is in progress. Although 17-ketosteroid does not serve as index of ovarian function, as ovary is not known to produce any neutral-17-ketosteroid, females of varying ages have been included in the investigation. The idea of including the females in the investigation is to find out values against which the values obtained in females presumably suffering from adrenocortical tumours, as evidenced by symptoms like hirsutism etc. can be compared for diagnosis and prognosis.

18. Suppression of Adrenocorticotrophic Hormone (ACTH) Release in Normal Stressed Rats after Hydrocortisone Injection.

B. N. CHOWDHURI and S. P. SEN, Calcutta.

Compensatory atrophy of adrenal cortisones in normal rats has been observed after prolonged administration of adrenal cortical hormones. This atrophy has been attributed to the suppression of activity of the gland due to inhibition of secretion of addenocorticotrophic hormones (ACTH). Experiments have been conducted in intact rats to study the effect of hydrocortisone injection (intramuscular) on ACTH release after stress. It has been observed that adequate dosage of hydrocortisone injection suppresses the release of ACTH after stress. Depletion of adrenal ascorbic acid has been used as an index for judging the activity of ACTH. While the release of ACTH is suppressed in normal rats pretreated with hydrocortisone marked ACTH release is observed in controlled animals not so pretreated.

19. Studies in Induced Hypothyroidism : Effects of Hypothyroidism on body growth of Young and Adult male Rats.

J. S. RAWAT, Mathura.

Young (85.8 gms.) and adult (212.0 gms.) male rats were divided into two groups. Hypothyroidism was induced in one by administering thiourea in their

food for 28 days and the other was used as control. Animals were pair fed and weighed at intervals of 4 days. The results obtained are given below : Average food intake 15.0gm/rat/day; thiourea intake 15.0/mg/rat/day; initial body weight young expl. (YE) $85.8g \pm 0.72$, Young Control (YC) $85.8g \pm 0.72$; final body weight (YE) $93.2g \pm 2.00$, (YC), $109.5g \pm 2.10$; initial body weight, Adult Expl. (AE) $213.0gm \pm 4.4$, Adult Control (AC) $212.0g \pm 3.8$; final body weight (AE) 207.0 ± 5.2 , (AC) $216.0g \pm 5.2$.

20. Studies in Induced Hypothyroidism : Effect of Hypothyroidism on weight of Glands of Young Male Rats.

J. S. RAWAT, Mathura.

The young animals used in the previous experiment (Studies in Induced Hypothyroidism, Part I) were sacrificed at the end of 28 days and the dissected out glands were weighed. The weights of right adrenal, left adrenal, pituitary, and thyroid (in mg.) and of seminal vesicles, testis and liver (in g.) of both the groups were : Right Adrenal, (YE), 6.64 ± 0.288 , (YC), 9.71 ± 0.320 ; Left Adrenal, (YE), 6.86 ± 0.147 , (YC), 10.43 ± 0.296 ; Pituitary (YE), 6.18 ± 0.162 , (YC), 4.50 ± 0.290 ; Thyroid, (YE), 31.78 ± 1.190 , (YC), 7.93 ± 0.427 ; Seminal Vesicles, (YE), 0.247 ± 0.036 , (YC), 0.443 ± 0.033 ; Testis, (YE), 1.45 ± 0.050 , (YC), 1.65 ± 0.034 ; Liver, (YE), 3.830 ± 0.061 , (YC), 3.677 ± 0.048 . The difference in weights were statistically highly significant.

Results when expressed as per 100 gms. body weight are : Right Adrenal, (YE), 7.19 ± 0.382 , (YC), 8.90 ± 0.382 ; Left Adrenal, (YE), 7.32 ± 0.208 , (YC), 9.55 ± 0.296 ; Pituitary, (YE), 6.67 ± 0.205 , (YC), 4.15 ± 0.151 ; Thyroid, (YE), 34.23 ± 1.260 , (YC), 7.29 ± 0.433 ; Seminal Vesicles, (YE), 0.258 ± 0.035 , (YC), 0.452 ± 0.030 ; Testis, (YE), 1.548 ± 0.051 , (YC), 1.510 ± 0.041 ; Liver, (YE), 4.129 ± 0.058 , (YC), 3.368 ± 0.054 . The differences were statistically significant in each case.

21. Studies in Induced Hypothyroidism : Effect of Hypothyroidism on weight of Glands of Adult male rats.

J. S. RAWAT, Mathura.

The adult animals used in the previous experiment (Studies in Induced Hypothyroidism, Part I) were sacrificed at the end of 28 days and the dissected out glands were weighed. The weights of right adrenal, left, adrenal, pituitary thyroid (in mg.) and of seminal vesicles, testis and liver (in gm.) of both the groups were : Right Adrenal, (AE), 11.4 ± 0.373 , (AC), 13.00 ± 0.442 ; Left Adrenal, (AE), 12.6 ± 0.577 , (AC), 13.90 ± 0.577 ; Thyroid, (AE), 43.30 ± 1.08 , (AC), 16.60 ± 1.15 ; Pituitary, (AE), 8.0 ± 0.311 , (AC), 6.4 ± 0.488 ; Seminal Vesicles (AE), 1.346 ± 0.126 , (AC), 1.691 ± 0.100 ; Testis, (AE), 2.59 ± 0.078 , (AC), 2.59 ± 0.138 ; Liver, (AE), 8.129 ± 0.538 , (AC), 7.086 ± 0.327 . The differences in weights of Adrenals, Thyroid, Pituitary and Liver in the two groups were statistically significant and that of seminal vesicles and testis not significant.

The results when expressed as 100 gms. body weight were Right Adrenal, (AE), 5.48 ± 0.119 , (AC), 6.0 ± 0.261 ; Left Adrenal, (AE), 6.02 ± 0.211 , (AC), 6.44 ± 0.331 ; Pituitary, (AE), 3.83 ± 0.124 , (AC), 2.98 ± 0.282 ; Thyroid, (AE), 20.83 ± 0.692 , (AC), 7.66 ± 0.527 ; Seminal Vesicles, (AE), 0.640 ± 0.049 , (AC), 0.781 ± 0.048 ; Testis, (AE), 1.25 ± 0.066 , (AC), 1.19 ± 0.040 ; Liver, (AE), 3.877 ± 0.150 , (AC), 3.255 ± 0.075 . The differences in weights of Pituitary, Thyroid and Liver were statistically significant and of adrenals, seminal vesicles and testis were not significant.

22. Studies in Induced Hypothyroidism : Biochemical change induced by Hypothyroidism in Young male rats.

J. S. RAWAT and A. ROY, Mathura.

The young animals used in the previous experiment (Studies in Induced Hypothyroidism, Part I) were sacrificed at the end of 28 days and adrenals, seminal vesicles and liver were dissected out and analyzed for constituents of biochemical importance. Results obtained are given below :

Adrenal gland : Ascorbic acid in mg. in left gland, young Expl. (YE), 0.01696 ± 0.0007 , young control (YC), 0.02781 ± 0.0017 ; Cholesterol in mg. in right gland, (YE), 0.617 ± 0.044 , (YC), 0.773 ± 0.037 .

When expressed as mg. per 100 mg. of the gland, the results are : Ascorbic acid, (YE), 0.2674 ± 0.0227 , (YC), 0.2884 ± 0.0221 ; Cholesterol, (YE), 8.759 ± 0.645 , (YC), 7.091 ± 0.671 ; Moisture content, (YC), $74.34\% \pm 1.34$, (YE), $73.19\% \pm 1.04$. Seminal Vesicles (values in mg.) The absolute content of (i) Fructose : (YE), trace, (YC), 0.1809 ± 0.0200 ; (ii) Inorganic phosphorus : (YE), 0.0599 ± 0.0082 , (YC), 0.0948 ± 0.0072 ; (iii) Ascorbic acid, (YE), 0.0263 ± 0.0019 , (YC), 0.0554 ± 0.0034 .

When expressed in mg. per 100 gms. of the gland, the results are : (i) Fructose, (YE), trace, (YC), 40.50 ± 2.176 ; (ii) Inorganic Phosphorus, (YE), 23.750 ± 1.752 , (YC), 20.740 ± 0.829 ; (iii) Ascorbic acid, (YE), 12.78 ± 1.483 , (YC), 12.91 ± 0.623 .

(The values are in g./100g. fresh liver). (i) Glycogen as glucose, (YE), 0.305 ± 0.042 , (YC), 0.404 ± 0.045 ; (ii) Moisture, (YE), $68.49\% \pm 0.290$, (YC), $69.61\% \pm 0.130$; (iii) Total nitrogen, (YE), 3.663 ± 0.044 , (YC), 3.873 ± 0.038 ; (iv) Total fat, (YE), 6.915 ± 0.320 , (YC), 4.474 ± 0.110 ; (v) Iodine value, (YE), 60.20 ± 1.75 , (YC), 51.00 ± 2.70 .

23. Studies in Induced Hypothyroidism : Biochemical changes induced by Hypothyroidism in Adult male rats.

J. S. RAWAT and A. ROY, Mathura.

The adult animals used in previous experiment (Studies in Induced Hypothyroidism, Part I) were sacrificed at the end of 28 days and adrenals, seminal vesicles and liver were dissected out and analyzed for constituents of biochemical importance. Results obtained are given below : Adrenal Gland : Ascorbic acid in mg. in left gland, adult Expl. (AE), 0.03110 ± 0.0007 , Adult Control, (AC), 0.03430 ± 0.0015 , Cholesterol in mg. in right gland, (AE), 0.873 ± 0.070 , (AC), 0.914 ± 0.060 .

When expressed as mg. per 100 mg. of the gland the results are Ascorbic acid, (AE), 0.276 ± 0.0062 , (AC), 0.262 ± 0.0065 ; Cholesterol, (AE), 7.219 ± 0.750 , (AC), 6.701 ± 0.370 . Moisture content of the gland, (AE), $65.35\% \pm 0.82$, (AC), $64.10\% \pm 0.59$.

Seminal vesicles : (values are in mg.). The absolute content of (i) Fructose, (AE), 0.602 ± 0.100 , (AC), 0.816 ± 0.065 ; (ii) Inorganic phosphorus, (AE), 0.2148 ± 0.0159 , (AC), 0.2900 ± 0.0140 ; (iii) Ascorbic acid, (AE), 0.0826 ± 0.0083 , (AC), 0.1400 ± 0.0091 .

When expressed in mg. per 100 gms. of the gland, the results are : (i) Fructose, (AE), 42.90 ± 3.45 , (AC), 48.10 ± 2.28 ; (ii) Inorganic phosphorus, (AE), 16.160 ± 0.625 , (AC), 17.361 ± 1.080 ; (iii) Ascorbic acid, (AE), 6.164 ± 0.270 , (AC), 8.372 ± 0.565 .

Liver : (the values are in g. per 100g. fresh liver. (i) Glycogen as glucose, (AE), 0.984 ± 0.400 , (AC), 0.770 ± 0.267 ; $67.77\% \pm 0.58$, (AC), (ii) Moisture, (AE), $68.52\% \pm 0.17$; (iii) Total nitrogen, (AE), 3.191 ± 0.101 , (AC), 3.519 ± 0.045 ; (iv) Total fat, (AE), 7.01 ± 0.383 , (AC), 4.86 ± 0.104 ; (v) Iodine value, (AE), 60.60 ± 3.54 , (AC), 52.00 ± 2.88 .

24. Studies in Induced Hypothyroidism : Effect of Discontinuance of Induced Hypothyroidism on Growth and Weight of Certain Glands.

J. S. RAWAT, Mathura.

Hypothyroidism was induced in immature Young Rats (85.0 gms.) by administering thiourea in their food. The experimental details were same as reported earlier (Effect of Induced Hypothyroidism, Part I). Thiourea feeding was discontinued after a period of 28 days and the animals were maintained on the same ration for another 15 days. The results obtained, are given below :

Body weight after 28 days feeding of thiourea Expl. Group, 93.9 ± 2.80 , Control group, 107.5 ± 2.10 ; Body weight 15 days after stopping thiourea feeding (E), 111.5 ± 2.0 , (C), 111.3 ± 2.13 .

Weight of glands : The weights of right Adrenal, left Adrenal, Pituitary, Thyroid (in mg.) and of seminal vesicles, Testis and Liver (in gms.) of both the groups were : Right Adrenal, (E), 7.90 ± 0.351 , (C), 9.30 ± 0.491 ; Left Adrenal (E), 9.44 ± 0.347 , (C), 10.94 ± 0.200 ; Pituitary, (E), 4.0 ± 0.00 , (C), 3.25 ± 0.167 ; Thyroid, (E), 20.40 ± 0.943 , (C), 9.90 ± 0.610 ; Seminal Vesicles, (E), 0.460 ± 0.095 , (C), 0.396 ± 0.035 ; Testis, (E), 1.74 ± 0.148 , (C), 1.92 ± 0.041 ; Liver, (E), 3.933 ± 0.103 , (C), 3.860 ± 0.060 . The differences in weights in Adrenals, Pituitary, and Thyroid in two groups were statistically significant and the differences are not significant in cases of seminal vesicles, Testis and Liver.

25. Studies in Induced Hypothyroidism : Effect of discontinuance of Induced Hypothyroidism on Biochemical changes in certain glands.

J. S. RAWAT and A. ROY, Mathura.

Immature young rats used in previous experiment (Studies in Induced Hypothyroidism, Part VI) were sacrificed at the end of the experimental period and the glands were dissected out and analyzed. The results obtained are given below : Adrenal : Moisture, (E), $70.77\% \pm 1.32$, (C), $66.90\% \pm 1.17$; Ascorbic acid (in mg.) in left gland, (E), 0.0227 ± 0.0007 , (C), 0.0258 ± 0.0010 ; Cholesterol in mg. in right gland, (E), 0.474 ± 0.030 , (C), 0.738 ± 0.045 .

When expressed as mg. per 100 mg. of the gland, the results are : Ascorbic acid, (E), 0.2921 ± 0.0139 , (C), 0.2818 ± 0.0112 ; Cholesterol, (E), 5.073 ± 0.481 , (C), 6.729 ± 0.284 .

Seminal vesicles (the values are in mg.) the absolute content of (i) Fructose, (E), 0.170 ± 0.044 , (C), 0.126 ± 0.022 ; (ii) Ascorbic acid, (E), 0.0442 ± 0.0074 , (C), 0.0367 ± 0.0032 ; (iii) Inorganic phosphorus, (E), 0.1002 ± 0.0140 , (C), 0.097 ± 0.0050 .

When expressed as mg. per 100 mg. of the gland, results are : (i) Fructose, (E), 37.73 ± 1.966 , (C), 33.67 ± 1.704 ; (ii) Ascorbic acid, (E), 10.432 ± 0.812 , (C), 9.339 ± 0.401 ; (iii) Inorganic phosphorus, (E), 20.780 ± 1.00 , (C), 23.770 ± 1.643 .

Liver (the values are in gm. per 100 gm. fresh liver) : (i) Moisture, (E), $69.89\% \pm 0.213$, (C), $69.06\% \pm 0.250$; (ii) Glycogen as glucose, (E), 0.690 ± 0.180 , (C), 0.410 ± 0.077 ; (iii) Total nitrogen, (E), 3.577 ± 0.055 , (C), 3.728 ± 0.051 ; (iv) Total fat, (E), 3.902 ± 0.420 , (C), 4.025 ± 0.301 .

26. Studies in Induced Hypothyroidism : Effect of hypothyroidism on body growth and weight of glands of young male rats in different seasons.

J. S. RAWAT, Mathura.

Hypothyroidism was induced by incorporating 10 mg. thiourea in the food of each rat in a group of young male rats (115.0 gms.) during the humid and warm

months of July and August (Expt. A). Another group of rats of approximately the same weights served as control. The rats in the two groups were pair fed. Thiourea feeding was continued for a period of 45 days. The animals were weighed regularly after an interval of 4 days. At the end of the experimental period the animals were sacrificed and the dissected out glands were weighed. Results obtained are given below : Average food intake 11.0 gms/rat/day; average thiourea intake 8.6 mg/rat/day; initial body weight, (gms.) Expl. (E) group 115.0 ± 1.5 ; control (C) group, 115.0 ± 1.60 ; final body weight (gm.) (E), 131.0 ± 2.10 ; (C), 130.0 ± 2.30 . The weights of right and left adrenal, pituitary and thyroid in mg. and of seminal vesicles and liver (in mg.) of both the groups were : Right adrenal, (E), 7.00 ± 0.22 ; (C), 10.60 ± 0.41 ; Left adrenal, (A), 7.58 ± 0.26 , (C), 11.5 ± 0.26 ; Pituitary, (E), 7.66 ± 0.29 , (C), 4.50 ± 0.18 ; Thyroid, (E), 32.50 ± 2.00 , (C), 8.07 ± 0.41 ; Seminal vesicles, (E), 0.385 ± 0.066 , (C), 0.633 ± 0.044 ; and Liver, (E), 3.93 ± 0.30 , (C), 2.90 ± 0.12 . The differences in weight of glands in the two groups were statistically highly significant.

Experiment B—The same experiment was repeated during winter months of November and December and results obtained were : Average food intake 15 mg/rat/day, average thiourea intake 10 mg/rat/day; initial body weight, (E), $104g. \pm 1.40$, (C), $102.5g. \pm 1.16$; Final body weight, (E), 131.00 ± 1.29 ; (C), 126.50 ± 1.53 ; Right adrenal, (E), 8.68 ± 0.50 , (C), 10.60 ± 0.78 ; Left adrenal, (E), 10.80 ± 0.20 , (C), 12.50 ± 0.20 ; Pituitary, (E), 5.10 ± 0.31 , (C), 4.71 ± 0.29 ; Thyroid, (E), 27.40 ± 1.24 , (C), 9.46 ± 0.37 ; Seminal vesicles, (E), 0.274 ± 0.024 , (C), 0.297 ± 0.034 . The differences in weights of thyroid, adrenals and liver were statistically significant; but there was no significant difference in the weights of pituitary and seminal vesicles.

Experiment C—The experiment was repeated again during the winter months of January-February; but this time 15.0 mgm. of thiourea was incorporated in the feed of each rat in the experimental group. Results obtained were : Average food intake, 15.0 gm/rat/day; Average thiourea intake, 15.0 mg/rat/day; initial body wt., (E), $84.40g \pm 2.60$; (C), 83.80 ± 2.37 ; Final body weight, (E) $123.00g \pm 1.15$, (C), $120.40g \pm 2.64$. Right adrenal, (E), 9.10 ± 0.444 , (C), 11.20 ± 0.164 ; Left adrenal, (E), 10.500 ± 0.415 , (C), 12.70 ± 0.414 ; pituitary, (E), 5.550 ± 0.260 , (C), 4.620 ± 0.208 ; thyroid, (E), 37.50 ± 2.56 , (C), 9.25 ± 0.457 ; Seminal vesicles, (E), 0.415 ± 0.038 , (C), 0.666 ± 0.041 ; liver, (E), 6.520 ± 0.159 , (C), 4.470 ± 0.178 . The differences in weights in the two groups were statistically highly significant in each case.

27. Studies in Induced Hypothyroidism : Effect of hypothyroidism on biochemical changes induced in certain glands in different seasons.

J. S. RAWAT, Mathura.

Animals used in the previous experiments (Studies in Induced Hypothyroidism, Part VIII) in the different seasons were sacrificed at the end of experimental periods and adrenals and seminal vesicles were analyzed for the different constituents of biochemical importance. The results obtained are given below : Expt. A : (July and August) Adrenals : Percent Moisture, (E), 65.8 ± 2.6 , (C), 62.1 ± 1.5 ; Ascorbic acid (mg), (E), 0.0249 ± 0.0014 , (C), 0.0344 ± 0.0016 ; Cholesterol (mg), (E), 0.263 ± 0.050 , (C), 0.707 ± 0.160 . The difference in the two groups was statistically significant in case of ascorbic acid cholesterol content. Seminal vesicles : Fructose (mg), (E), Trace, (C), 0.4297 ± 0.0170 ; Inorganic phosphorus (mg), (E), 0.062 ± 0.002 , (C), 0.137 ± 0.006 . The difference in the two groups was statistically highly significant.

Expt. B. (November & December)

Adrenal : Percent Moisture, (E), 72.80 ± 1.71 , (C), 70.00 ± 1.12 ; Ascorbic acid (mg), (E), 0.03380 ± 0.00136 , (C), 0.03640 ± 0.00095 ; Cholesterol (mg), (E), 0.521 ± 0.026 , (C), 0.667 ± 0.030 . Only the difference in cholesterol control in the two groups was statistically significant. There was no significant difference in the moisture and ascorbic

acid content. Seminal vesicles : Fructose (mg) (E), 0.1555 ± 0.0260 , (C), 0.1068 ± 0.0160 ; Inorganic phosphorus (mg) (E), 0.0763 ± 0.0063 , (C), 0.0725 ± 0.0051 . Statistically the differences in both the cases were not significant.

Expt. C. (January and February)

Adrenals : Percent moisture, (E), 70.20 ± 1.567 , (C), 65.300 ± 1.488 ; Ascorbic acid (mg) (E), 0.02090 ± 0.00059 , (C), 0.03160 ± 0.00155 ; Cholesterol (mg) (E), 0.599 ± 0.033 , (C), 1.075 ± 0.201 . The differences in each case were statistically significant. Seminal vesicles : Fructose (mg), (E), 0.2081 ± 0.0210 , (C), 0.3051 ± 0.0290 ; Inorganic phosphorus (mg) (E), 0.1160 ± 0.0094 , (C), 0.1718 ± 0.0093 . The differences in both the cases were statistically significant.

REPRODUCTION

28. A quantitative evaluation of the effects of gonadotrophic hormones on the sex glands and organs of experimental animals (rats and mice).

S. C. BHATTACHARJEE, B. N. CHOWDHURI and M. D. CHAKRAVARTI,
Calcutta.

A quantitative study has been made of the effects of chorionic and serum gonadotrophins on the sex glands and organs of small experimental animals—rats and mice. Different graded doses of the International Standard gonadotrophins were injected into the animals and increases in weight of the organs were determined as compared to those in control animals. Statistical analysis of experimental results showed that chorionic gonadotrophin had more powerful effects on the sex glands of female animals than those of serum gonadotrophin. On the other hand, serum gonadotrophin had more powerful effects on the sex glands of male animals than those of chorionic gonadotrophin.

29. Biochemistry of Guineapig Semen.

A. K. CHOWDHURY, A. GOSWAMI and P. B. SEN, Calcutta.

The semen of guineapigs like that of some other rodents coagulates almost immediately after ejaculation. The coagulated mass contracts into a hard tenacious mass within very short time without leaving out any serum like fluid. The ejaculated whole semen was analysed for total nitrogen, ascorbic acid, phosphatase and cholesterol. It was found that the nitrogen percentage varies between 8-12% in the whole ejaculate. The ascorbic acid value was found to be between 4-8%. The major portion of guineapig semen is composed of seminal vesicular secretion. Therefore the alkaline phosphatase activity was found to be invariably higher than that of acid phosphatase activity. The alkaline phosphatase activity varied between 28-40 Bodensky units while the acid phosphatase activity varied between 6-13 Bodensky units.

30. Effect of Infra-red irradiation on the cyclophorase system of guineapig testis.

A. K. CHOWDHURY, A. GOSWAMI and P. B. SEN, Calcutta.

Mammalian spermatogenesis requires an optimum temperature in the scrotum. This optimum temperature is slightly below the body temperature and raising or lowering of the scrotal temperature above or below this optimum temperature results in serious damage to the germinal epithelium. The actual reason of this susceptibility is still unexplained. We examined the cyclophorase enzyme system imme-

diately after irradiation to find out how these enzymes are affected. It was found that the activity of the succinic dehydrogenase and cytochrome oxidase was significantly diminished in the irradiated testis homogenates, when compared with a normal one.

31. Biological Assay of the Oestrogenic Content of the Gel Mass of Rabbit Semen.

D. P. MUKHERJEE, Izatnagar, U.P.

It has been reported previously by the author that the gel mass of rabbit semen contains oestrogenic substance which is absorbed in the vagina of rabbit causing thereby hyperfunction of the ovaries, the adrenals, the thyroid and the pituitary. In the present article the author reports the biological assay of the gel mass. It has been found that 1.5 gms. of the gel mass has the same effect on uterine weight of immature rats as 5.43 micrograms of oestradiol dipropionate. It was concluded that the oestrogenic potency of a known quantity of the gel mass may not be static. It may vary during different seasons of the year.

32. Suitable Position of the Estrus Cycle in rats for standardization of Posterior Pituitary Lobe Extract.

N. K. ROY, A. N. BOSE and SRIPATI BOSE, Calcutta.

Uteri of white albino rats (120-200 gm weight) behave differently during different phase of the estrus cycle, under stimulation from Pituitary Posterior lobe extract. Spontaneous activity increases as the cycle progresses towards peak estrus. Spontaneous activity during di-estrus and pro-estrus, when present, ceases automatically in modified Locke's solution. Same during other stages may also be controlled in majority of cases. But while the uteri in di-estrus remain sluggish, those in pro-estrus work well with brisk, regular and uniform responses of high magnitude. As the sexual cycle progresses, it is however found that the brisk, regular and uniform responses are replaced by more and more sluggish irregular and erratic ones and fatigue supervenes very early. Observations on a good number of animals reveal that the mother rats in rest are the animals of choice for assay work, and in the sequence pro-estrus, estrus and post-estrus, spontaneous activity increases and the precision of the assay decreases. The animals in pro-estrus and early estrus are best suited for standardization of Pituitary Posterior lobe extract, using isolated rat uterus as a test preparation. Unnecessary loss of experimental animals, time and material, may be prevented if the animals are selected accordingly. Variation between results obtained during pro-estrus and early estrus is not of much significance, so there can be very little difficulty in selection of animals. Difference in response as the sexual cycle progresses suggests some progressive physico-chemical change in the uterine musculature with the progress of the sexual cycle and requires thorough investigation.

NERVOUS SYSTEM

33. The release of hypothalamic polypnoeic centre from rostral control.

S. R. DASGUPTA, Calcutta.

It was noticed during acute experiments with a view to prepare diencephalic cats that following the frontal section through the hypothalamus, 13 cats out of 64 exhibited a panting type of respiration. Such respiratory changes were not noticed

in decerebrate cats. This led to the consideration of the possibility of the frontal section being at such a level whereby some polypnoeic centres were released from rostral inhibitory control.

In the present series 12 cats were operated. After bilateral decortication the frontal section was made (1) as far anteriorly as possible, (2) immediately in front of the optic chiasma and (3) immediately in front or through the tubercinerium. Polypnoea developed only in those cats (six in this series) where the frontal section passed immediately in front of the optic chiasma.

There are evidences to show that there is an area in the anterior periventricular region the stimulation of which causes polypnoea. It has also been shown by various authors that certain areas of the cerebral cortex are concerned with the control of respiration the stimulation of which slows down or inhibits respiration. These areas have further been shown to be connected to the anterior periventricular region through efferent fibres.

It is suggested that, normally in intact animals an anterior periventricular hypothalamic tachypnoeic (polypnoeic) centre, might be kept tonically inhibited by rostrally situated centres in the cerebral cortex which exert their inhibitory control through the corticohypothalamic fibres described above. The severance of these fibres removes the cortical control over this hypothetical hypothalamic centre.

34. Control of the Limbic System of Brain ('Visceral Brain') over certain Vegetative Functions.

B. K. ANAND, New Delhi.

Phylogenetic and cytoarchitectural studies, together with recent physiological investigations, suggest that the limbic system of the brain represents an early neural development involved in the higher control of autonomic nervous system and in the affectively determined behaviour. This system, comprises the cortical regions like the orbitomesial surface of the frontal lobes, the anterior cingulate gyrus, the anterior insular area, the temporal polar area, the pyriform cortex, the hippocampal and dentate gyri, and the uncus; and the associated sub-cortical cell stations like amygdaloid nuclei, and the hippocampus. Limbic system has a marked influence over the viscera controlled by the autonomic system, hence the designation 'visceral brain'.

This paper summarises the studies on 29 cats and 13 monkeys, in whom multilead electrodes were implanted in different parts of the limbic system, and these were stimulated in waking animals with square wave pulses—30/sec.; 0.2 to 1 msec. duration; 3 to 8 volts intensity.

(1) *Affective behaviour*—showed marked and varied changes. Temporal lobe structures excluding the tip made majority of animals agitated and fearful, and quietened some. Temporal tip stimulation in cats made them very irritable. Temporal tip in monkeys and posterior orbital cortex just rostral to it in cats made them vicious and violent. Orbital stimulation made them quiet, while anterior cingulate made them violent and in cats produced convulsions and rage reaction.

(2) *Somatic movements*—of face and head muscles were produced. "Eating" automatisms with salivation also occurred, but no change in food intake.

(3) *Autonomic activity*—both sympathetic and parasympathetic, like lachrymation, salivation, pupillary changes, movements of nictitating membrane, changes in heart rate, and more rarely urination and defaecation, was produced from widespread points.

(4) *Blood Pressure*—was usually raised from temporal tip, posterior orbital, and anterior cingulate stimulation; and lowered from temporal lobe structures.

(5) *Respiration*—usually inhibited from amygdala; and both inhibited and accelerated from different points in other structures.

(6) *Blood Sugar*—level is raised on all limbic stimulation, except stimulation of anterior cingulate in cat which lowers it.

(7) *Gastric motility*—is inhibited from temporal lobes, and both increased and inhibited from other regions.

Gastric secretion (volume, HCl, and Pepsin contents both increased, as well as decreased on limbic stimulation.

VITAMINS

35. Metabolic Behaviour of Lambs in Vitamin A Deficiency.

N. D. KEHAR, P. C. SAWHNEY and A. N. BAHL, Izatnagar, U.P.

2-3 months old lambs were maintained on vitamin A deficient diet which was adequate in all other respects. Metabolism trials were conducted on these animals at 15, 15, 40 and 50 weeks of experimental feeding during progressive stages of the depletion of vitamin A.

The nitrogen balances were positive at all stages. The average balance per lb. live weight was about 0.1745 gm. at 50 weeks while at 40 weeks it was 0.2371 gm. The average digestibility coefficient of nitrogen at 40 weeks was 84.44 per cent and at 30 weeks 86.29 per cent. Thus the digestibility coefficient of nitrogen was not significantly affected by vitamin A deficiency.

The calcium and phosphorus balances were throughout positive, but inspite of this skeletal growth was poor.

The digestibility of dry matter is not affected by the vitamin A deficiency. The average coefficient of digestibility of dry matter was 73.10 per cent and 74.60 per cent at 40 and 50 weeks of experimental feeding.

36. Observations on the Biosynthesis of Nicotinic Acid by Guineapigs.

NARESH CHANDRA GHOSH, KANTIPADA CHATTOPADHYAY and
SACHCHIDANANDA BANERJEE, Calcutta.

Tryptophan is the precursor of nicotinic acid in mammalian species. The efficiency of this conversion, however, differs in different mammals. The mechanism of biosynthesis of nicotinic acid from tryptophan has been studied in guinea-pigs which is less efficient in converting tryptophan to nicotinic acid.

The oral administration of dl-tryptophan for two consecutive days increased considerably the urinary excretion of quinolinic acid. Nicotinic acid excretion also was slightly increased. Trigonelline, which was normally excreted in the urine, was definitely increased after administration of tryptophan. The administration of tryptophan in animals fed a diet deficient in trigonelline, did not increase the trigonelline excretion indicating that trigonelline is not a metabolic end product of tryptophan metabolism. The oral feeding of N-methylnicotinamide (NMN) and quinolinic acid did not increase the nicotinic acid or trigonelline excretion indicating that nicotinic acid is not synthesised from quinolinic acid or N-MN. Administration of anthranilic acid elevated the excretion of quinolinic acid and trigonelline but the excretion of nicotinic acid remained unchanged. The synthesis of nicotinic acid from tryptophan takes place in guinea-pigs but this conversion does not seem to proceed through quinolinic acid.

The injection of carbontetrachloride after feeding trigonelline caused an increased excretion of trigonelline on the 2nd day of the injection, but the sum total excretion of trigonelline for 4 days was more or less similar to uninjected animals.

37. Influence of Hypervitaminosis A on Tissue Respiration.

AMAL ROY and D. P. SADHU, Calcutta.

Respiration studies have been made with a Warburg apparatus in liver and brain homogenates of control rats and hypervitaminotic A rats fed 15,000 units of vitamin A daily for about 45 days. It has been found that oxygen consumption is less in hypervitaminotic group upto the total period of 60 minutes. Respiration is increased in both groups after addition of succinate and ascorbate substrates, but the respiration in hypervitaminotic group never reaches the normal value. Depression of respiration is not corrected by these substrates.

38. Effect of Hypervitaminosis A on Oestrous Cycle of Rats.

NANDITA BOSE and D. P. SADHU, Calcutta.

Hypovitaminosis A cause cornification of vaginal epithelium which is similar to the cornification of the vaginal epithelia produced during oestrus or by the action of oestrogenic hormones. Hypervitaminosis A induced in female albino rats by the administration of 5,000 units of vitamin A daily led to a prolongation of the period of oestrous cycles in these rats to 12 days in place of the normal period of 7 days. This action might be due to a topical action of vitamin A on the epithelia by counteracting the biological effects of oestrogen thereon.

METABOLISM AND NUTRITION**39. Measurement of Energy Metabolism in Goats.**

S. P. BHATNAGAR and D. P. SADHU, Calcutta.

Resting energy metabolism has been estimated in goats of Jamnapuri breed by the Benedict Roth apparatus, in which the human facemask was replaced by a specially devised mask. Since the volume of the spirometer is affected by the methane exhaled by the goats, the spirometer does not give an accurate idea of Oxygen consumption, the error amounting to about 3%. The expired air was collected in a Douglas bag and analyzed for methane and the true oxygen consumption was determined in this way. The goat was then starved and the gas analysis and spirometry done every three hours and it was found that the basal metabolism is reached in goats by 45-48 hours when the oxygen consumption is 109 ml. per 10 minutes. This has been correlated with the surface area of the goats.

40. Physiological Reactions of the Calves under Humid Tropical Climate.

N. D. KEHAR and B. S. KAUSHAL, Izatnagar.

It has been reported earlier from these laboratories that higher air temperature is not conducive to optimum health and productivity of the animals. Further studies have been extended to find out whether higher humidity has also the same deteriorating effect on the physiological processes in the animal system.

These experiments have been carried out on 24 Haryana and 16 Bengal young calves. They were divided into groups of 8 each. One group of the Haryana calves was kept at Hissar and the other two at Calcutta, one group of the Haryana breed and the other of the Bengal breed are fed on Bengal diet where as the others are fed on Hissar diet.

Records of weekly body weight, pulse rate, respiration rate, body temperature, live weight, water intake and dry matter intake are maintained at regular intervals.

These observations have been in progress for one year. The results showed differences in the respiration rate, live weight, water and dry matter intake between the breeds. Little differences, in some of the analytical figures, were recorded between the dietary treatments within the breeds.

41. Effect of Acetoacetate on the Adrenal Cholesterol and Ascorbic Acid of Guinea-pigs.

M. C. NATH and S. G. NAYUDU, Nagpur.

Effect of repeated injection of acetoacetate on the adrenal cholesterol and ascorbic acid of guinea pigs has been studied.

Acetoacetate has no effect on the adrenal cholesterol, free or total, either on the scorbutic or normal guinea pigs. Blood cholesterol values also remain unaltered both in normal as well as scorbutic guinea pigs.

Adrenal ascorbic acid is low in scorbutic guinea pigs and although acetoacetate causes further depletion, no appreciable stress effect is evident as the adrenal weights do not increase.

All the animals injected acetoacetate, showed mild glycosuria and ketonuria.

Acetoacetate does not seem to cause its diabetogenic effect through appreciable adrenal cortical stimulation.

42. Reaction of Alloxan with Ascorbic Acid.

M. C. NATH and E. P. M. BHATTATHIRY, Nagpur.

It has already been reported that 1 : 2 dienol form of glucose liberated from the condensation product of glucose and acetoacetate on hydrolysis reacts with alloxan.

Experiments were performed to study the reaction of ascorbic acid, which has an enolic structure, with alloxan.

Ascorbic acid and alloxan in the molecular proportions of 1 : 1 and 1 : 2 were allowed to react at pH 7.2 and ascorbic acid content was estimated from time to time. Dehydroascorbic acid formed during the reaction was also determined. A portion of the dehydroascorbic acid was found to be lost due to its further transformation to CO_2 and other degradation products.

When one molecule of ascorbic acid was allowed to react with 2 molecules of alloxan, the loss of dehydroascorbic acid and liberation of carbon dioxide were almost double than those when the molar proportion was 1 : 1, thus suggesting the possibility of one molecule of ascorbic acid combining with 2 molecules of alloxan.

It has also been shown that alloxan is converted to alloxantin in such reaction.

43. Prevention of Dehydroascorbic Acid Diabetes by Sodium Salt of the Condensation Product of Glucose and Acetoacetate.

M. C. NATH, V. K. SAHU and R. M. BEHKI, Nagpur.

The prevention of dehydroascorbic acid diabetes by the sodium salt of the condensation product of glucose and ethyl acetoacetate was studied. The Na salt of the condensation product, when injected prior to the diabetogenic dose of dehydroascorbic acid, was found to prevent completely the dehydroascorbic acid diabetes.

The compound is without effect when administered ten minutes after dehydro-ascorbic acid injection.

Possibility of the presence of glucose in combination with acetoacetate as a defence mechanism has further been envisaged.

44. Role of Pantothenic Acid in Diabetic Cholesterogenesis.

SAILEN MOOKERJEA, Nagpur.

Free and ester cholesterol values are obtained from the different tissues of the four series of animals : Series I (Control), series II (Excess pantothenate fed), series III (diabetic) and series IV (diabetes and excess pantothenate fed). Series II and III animals showed small rise of cholesterol in certain tissues to different extents. Series IV animals, where excess pantothenate feeding has been superimposed on diabetes showed an added effect of the two conditions as regards the rise of cholesterol in certain tissues. Sugar and acetoacetate excretion showed a sharp decline of excretion after a preliminary rise in series IV. Growth curve of the animals also show that in series IV, pantothenate feeding prevents the weight loss of the diabetic animals.

Perhaps the availability of more co-enzyme A due to excess pantothenate feeding guides the course of unoxidised acetate and overproduced acetoacetate towards further synthesis of cholesterol in the body. The importance of both the factors, i.e. the availability of co-enzyme A and size of acetate pool, for the cholesterol synthesis has been stressed.

45. Cholesterol Synthesis in Diabetes.

SAILEN MOOKERJEA, Nagpur.

Sadhu and Mookerjea's hypothesis that there exists a plausible relationship between prolonged depression of tricarboxylic acid cycle and increased synthesis of cholesterol from acetate and acetoacetate has been re-investigated in condition of diabetes.

Free and ester cholesterol values of blood, liver and kidney of alloxan diabetic rats of 2-3 weeks and 6-7 weeks period of the experiments showed some significant rise of cholesterol only towards the latter period of experiment. Acetoacetate formation from acetate (Q_{AcAc}) of diabetic liver has also been found to be considerably increased. Oxidation of acetoacetate and succinate is unaffected in liver slices of diabetics, while acetate oxidation shows some depression.

Kidney slices show gradual depression of acetate, acetoacetate and succinate oxidation in diabetes.

Observations indicate that in prolonged diabetes unoxidised acetate and over-produced acetoacetate tend to change their metabolic pathway in favour of cholesterol synthesis.

46. Galactose as a Lipotropic Agent in the Body

D. P. SADHU, Calcutta.

Fortyeight albino rats were divided into four groups, one group being fed lactose-free diet (C_0) and the other three were fed increasing concentrations of lactose by replacing sucrose of the synthetic diet Mixture (C_1, C_2, C_3) groups. All

rats were fed a synthetic mixture of casein, sucrose or sucrose and lactose mixture, codliver oil, cystine and vitamin mixture. Rats were paired, so that the lactose-fed rats were allowed the same amount of food as was eaten by their sucrose-fed mates, which eat the lowest amount of food. Rats were sacrificed after 6 weeks and their liver and kidney analyzed for choline, phospholipid, sphingomyelin and fat content. The fat and sphingomyelin content were reduced in the lactose-fed rats compared to the sucrose-fed rats, while the choline and phospholipid content were increased. Lecithin and cephalin content were also increased. This shows definitely that increased galactose concentration in the lactose-fed rats acts as a lipotropic agent.

47. Galactose as a Choline-sparing Agent in the Body.

D. P. SADHU, Calcutta.

Fortyeight albino rats were divided into two groups, one group being fed lactose-free diet (C_0) and the other fed lactose (C_3). Half of each of these groups received 50 mgm. choline chloride daily for six days only during the whole experimental period of six weeks. All rats were fed a synthetic diet of casein, sucrose with or without lactose, cocoanut oil, salt mixture, codliver oil, cystine and vitamin mixture. Rats were sacrificed after six weeks and their liver and kidney analyzed for choline, phospholipid, sphingomyelin, and fat content.

Lactose feeding increases food intake and the gain of body weight. There is increase in choline, lecithin and phospholipids and decrease in sphingomyelin content of tissues in lactose-fed rats. The higher lactose concentration in lactose-fed animals competes with choline phosphoric acid for the sphingosine base, resulting in diversion of choline to combine with fatty phosphoric acids to form lecithin. This indicates that galactose can spare choline in the body, as is also shown by feeding of extraneous choline chloride in the diet, when galactose helps the conversion of choline to cholamine and synthesis of cephalin.

48. Improvement on the Biological Efficacy of Pulse Proteins.

G. C. ESH, Calcutta.

Three series of experiments were conducted to investigate the nature and degree of improvement in the nutritive value of pulses like Bengal gram, Lentil, Green gram, Khesari (*L. Sativa*) etc. by feeding protein depleted rats (a) individual pulse proteins supplemented with essential amino acids, (b) pulse proteins supplemented with casein or groundnut cake and (c) different pulse proteins combined together. The results tend to show that the nutritive value of all the pulse digests is significantly increased as a result of supplementation with casein and amino acids like methionine and threonine. Groundnut supplementation however, could not raise their nutritive value to any significant extent excepting in case of Lentil. The combination—Lentil and groundnut yielded a product whose protein efficiency ratio was found higher than that of the combination Lentil and Casein particularly in presence of methionine.

When the various pulse digests were mixed together and the nutritive value studied it was observed that while the combination Bengal gram and Khesari yielded a poor product, the combination Khesari and Lentil produced a product superior in nutritive value when compared to that of constituent pulse digests.

49. Some New Edible Sources of Protein.

N. SUBRAMANIAN, M. V. L. RAO and M. SRINIVASAN, Mysore.

Among the little known foods so far investigated in this laboratory, the seeds of 'Rajgira' (*Amaranthus paniculatus*), of the bamboo (*Bambusa arundinacea*, Willd.) and of Agati (*Sesbania grandiflora*, Pers.) have been found to be promising sources of edible proteins.

The seeds of *Amaranthus paniculatus* are now grown as a minor millet in several parts of the country. The seeds contain 14-16% protein, 66-8% carbohydrate, and 3-6% ash of which 18% is phosphorus and 6% calcium. The biological value of the proteins is 73.7 ± 1.25 . The seeds have a tough seed coat, which is not easily penetrated by water, and hence can be consumed only after puffing. The puffed grains constitute a high class breakfast food.

Bamboo seeds, a well known famine food but normally consumed only by the forest tribes, contain 12% protein, 0.86% fat and 74% carbohydrate. The proteins are of high nutritional quality, their biological value being 74.4 ± 1.44 . The grains cook and taste like rice. They can be safely consumed as a supplementary cereal wherever available.

The seeds of *Sesbania grandiflora* contain as much as 68% protein, perhaps the highest among vegetable materials. Animal experiments, however, reveal that their biological value is of a very low order (38). Chromatographic examination of the seed proteins has shown that the limiting essential amino acid is methionine which is present only to the extent of 0.5%.

50. Protein Requirement of Growing Lambs.

N. D. KEHAR, P. C. SAWNEY and A. N. BAHL, Izatnagar, U.P.

Eighteen 2 to 3 months old lambs were selected and divided into 3 groups of six each as uniformly as possible on the basis of their live weight. They were maintained on three levels of protein intake i.e. 0.05 (I), 0.04 (II) and 0.03 (III) lb. D.C.P. per 10 lb. body weight.

The ration consisted of a concentrate mixture, green and a good quality hay and was computed according to the three levels of intake. The animals were given clean water *ad lib.* and adequate supply of mineral mixture. The animals were weighed weekly and the amount of ration adjusted according to body weight.

The lambs continued getting milk as long as they were not able to take solid food—protein supplied by milk being accounted for while computing the ration.

The average weight gain in each group I (0.05), II (0.04) and III (0.03) after the first 21 weeks of experimental feeding was 10 lb. 3 oz., 9 lb. 7 oz. and 6 lb. 9 oz. In order to have a wider range of protein intake, each group was sub-divided into two. Three animals of group I were raised to 0.07 lb. D.C.P. per 10 lb. body weight. (Group IA) three of group II raised to 0.06 lb. D.C.P. per 10 lb. weight (Group IIA) and two of group III raised to 0.05 lb. D.C.P. per 10 lb. (Group IIIA). These groups were continued for 39 weeks more. The average gain in live weight was 22 lb. 11 oz., 23 lb. 8 oz., 33 lb. 15 oz., 26 lb., 35 lb. 13 oz. and 24 lb. 14 oz. at 0.07, 0.06, 0.05, 0.04, 0.05 and 0.03 lb. D.C.P. per 20 lb. body weight respectively.

Obviously the 0.5 lb. D.C.P. level both original and the one raised from 0.03 lb. D.C.P. level gave the best growth. Higher levels of protein intake did not show any advantage as regards live weight increase.

The results on statistical analysis showed significantly higher growth rate in 0.05 lb. D.C.P. group as compared to all the other groups.

This level of protein intake thus appears to be the requirement for growing lambs under the experimental conditions.

51. Some Observations, including clinical trials, on the use of Phenolphthalein as a Latent Colour for Vanaspati.

V. SUBRAHMANYAN, M. SRINIVASAN and T. R. DORAISWAMY, Mysore.

The use of phenolphthalein as a latent colour for Vanaspati has been described as part of a previous communication (V. Subrahmanyam, M. Srinivasan and V. R. Bhalarao, J. Sci. industr. Res., 1952, 11A, 277). In the present paper, certain properties of phenolphthalein, especially its solubility in fats on which there is no definite information, and clinical trials with phenolphthalein treated Vanaspati are described.

52. Common Salt as a Source of Dietary Calcium—Its influence on the Growth Rate of Rats fed on a rice diet.

D. SUBRAHMANYAM, N. SUBRAMANIAN and V. SUBRAHMANYAN, Mysore.

Common salt is an important dietary ingredient of the rice eating population, especially in South India, where the average *per capita* consumption as determined in a recent sample survey of about 2,000 houses in Mysore City, is 19.2 g. per day, equivalent to 25.6 g. per consumption unit. Common salt contains small amounts of minerals, notably calcium salts and preliminary observations by previous workers had suggested that common salt has beneficial effect on rat growth. The present investigations include analysis of a large number of samples of crude common salt for calcium and the effect of feeding rats on poor rice diet with the salt at 4.5% level. It is found that the common salt as available in the market is broadly classifiable into two main varieties, brown and white with an average Ca content of 353 mg% and 203 mg% respectively. It has been shown that common salt at 4.5% level in the diet enhances the growth rate of rats. Supplements of tamarind and chilli, which form part of the rice diet in South India, did not show any marked effect on the growth rate of animals.

53. Studies on feeding sarson (*Brassica campestris*) cake pressed by different methods on (1) Digestibility of proximate principles, (2) Milk yield and (3) Fat production.

N. D. KEHAR, P. N. JOHRI and B. S. KAUSHAL, Izatnagar.

In order to study the effect of sarson cake pressed by ghani, expeller and solvent extraction processes on the digestibility of different nutrients and also on milk yield and fat production, a long range experiment was undertaken on Haryana cows of almost similar age and stage of lactation. The cows were fed on a dairy mixture containing 50 parts of ghani, expeller or solvent extracted sarson cake, 30 parts gram husk, 10 parts barley, and 10 parts of crushed gram. Feeding observations extended over the entire lactation period.

A metabolism trial was carried out and it was noticed that except for ether extract there was no significant difference in the digestibility coefficients of crude protein, crude fibre, nitrogen-free-extract and total carbohydrates for the three dairy mixtures containing cakes pressed by different processes.

Observations on the effect of these cakes on milk yield and fat production are being statistically examined.

54. Effect of feeding sarson (*Brassica Campestris*) cake pressed by different methods on growth rate.

N. D. KEHAR, M. L. MATHUR and B. SAHAI, Izatnagar.

In order to study the effect of Sarson cake pressed by ghani, expeller and solvent extraction processes on the rate of growth 12 Haryana calves of 6 to 12 months of age were divided into three groups of four each. The first group was fed a calf mixture consisting of 50 parts of ghani pressed Sarson cake, 25 parts of barley, 12.5 parts of oat and 12.5 parts of wheat bran. The other two groups were given expeller pressed and solvent extracted cakes in place of the ghani pressed cake. The experimental observations were carried out for a period of one year.

Statistical analysis shows no significant difference in the growth rate of calves fed on calf mixtures containing Sarson cakes pressed by three different methods.

A metabolism trial was carried out and it is found that total digestible nutrients of the ration per 100 lb. dry matter containing solvent extracted, expeller pressed and ghani pressed sarson cakes were 56.9, 57.7 and 56.0 respectively.

55. Studies on the Effect of Different Levels of Fat on the Digestibility of Nutrients.

N. D. KEHAR, M. L. MATHUR and P. T. VERANDANI, Izatnagar.

In order to find out if different levels of fat in a ration effected the digestibility of various nutrients, an investigation was carried out on adult Kumauni cattle. The ration consisted of til (*Sesamum indicum*) cake pressed by ghani, expeller and solvent methods. The rations were made isocaloric in the expeller and solvent extracted groups by the addition of maize.

These rations were fed for a period of about a month. A metabolism trial was carried out during the last 10 days. The percentage level of fat in the ration of the Ghani pressed cake group was 3.48 and 2.00 and 1.15% in the expeller pressed and the solvent extracted cake groups respectively.

It was found that digestibility coefficients of crude protein and the utilisation of the total digestible nutrients in all the 3 groups was approximately of the same magnitude.

56. Studies on Goat Nutrition, Part I : Minimum Protein Requirement for maintenance endogenous urinary Nitrogen and Metabolic Faecal Nitrogen Excretion studies.

B. N. MAJUMDAR, Izatnagar, U.P.

1. Endogenous Urinary Nitrogen and Metabolic Faecal nitrogen excretions which are the necessary pre-requisites for an accurate assessment of the minimum protein requirements were determined by feeding goats on (a) a nitrogen-low ration and (b) a N-free ration. The average values obtained were, endogenous urinary nitrogen = 0.052 gm./kg. body weight and metabolic faecal nitrogen = 0.41 gm. per 100 lbs. dry matter intake.

2. The values obtained with the two feeding regimens for either the endogenous or the metabolic faecal nitrogen agreed very closely.

3. The minimum protein requirement for maintenance of goats calculated from the endogenous N value was 0.65 lb./100 lb. body weight.

4. The formula for calculating the utilisable protein requirement for the species was found to be $P = 0.89$, $W = 0.734$.

5. The above formula has also been found to be useful in predicting the endogenous urinary nitrogen of immature goats.

57. Goat Nutrition—Part II : Digestible Protein Requirement of Goats for maintenance from Balance Studies.

B. N. MAJUMDAR, Izatnagar, U.P.

1. Crude protein requirement of goats for maintenance has been determined by balance studies. The requirement per kg. found by three different methods of treatment of the balance data so collected is practically the same e.g. 2.63 gm. crude protein.

2. From the crude protein requirement as established above the digestible crude protein requirement has been calculated, again by two different methods. The values were practically similar and is fixed at 1.12 lb. per 100 lb. live weight. This value obtained from nitrogen balance studies is undoubtedly very much higher than the value (0.65 lb./100 lb.) obtained previously from endogenous urinary nitrogen determination alone.

3. Dry matter requirement of goats per 100 lb. live weight comes to about 3 lb. This value, on recalculation on the basis of live weight raised to the power 0.734, changes to be 2.6 lb. per 100 lb.

58. Goat Nutrition, Part III : Calcium and Phosphorus Requirements of Goats for maintenance.

B. N. MAJUMDAR, Izatnagar, U.P.

The calcium and phosphorus requirements of goats for maintenance have been determined from balance studies. The balance data obtained have been analysed by (a) the graphical method, (b) the statistical method and by the (c) percentage utilisation technique. All the results, which show close correlation, estimate the requirements to be 6.69 gm. calcium (or 9.37 gm. CaO) and 3.26 gm. phosphorus (or 7.47 gm. P_2O_5) per 100 lb. body weight. It appears that the goats need a little more of calcium than sheep of identical live weights.

59. Influence of the Quality and Quantity of Fluoride Dressings to the Soil on the Concentration of Fluorine in Lathyrus Sativus and a Few Selected Cereals.

B. N. MAJUMDAR, B. N. GUPTA and N. D. KERRAR, Izatnagar, U.P.

Lathyrus sativus and the cereals, wheat, oat and barley were raised on identical experimental plots manured with graded quantities of sodium and calcium fluorides. The seeds and grains, when harvested, were analysed for F, yielding results as follows :—

1. In general, the amount of F in the soil has no influence on the F content of crops raised on it.

2. While the above is generally true of lathyrus sativus seeds as well, it differs from the 3 cereal grains studied in one important respect. Lathyrus sativus has the peculiar property of drawing more F from the soil manured with an insoluble fluoride, viz., CaF_2 and concentrate it in its seeds. The percentage increase in F concentration over the control was roughly 70.

3. Lathyrus sativus grown in the same unmanured soil also had a slightly higher F content than that seen in the cereal grains raised simultaneously.

4. The experiment was repeated with almost identical results,

PHARMACOLOGY

60. Effect of Aq. Extract of *Symplocos Racemosa* (Beng. Lodh) on the Plain Muscle.

R. N. ROY and N. N. DAS, Calcutta.

Aq. extract of *Symplocos Racemosa* (Beng.—Lodh) in 1:1000 and 1:100 dilution has no marked effect on both the intestine and uterus. 1 c.c. of 1:10 dilution produces relaxation immediately then increases tonicity of muscle and amplitude of contraction of intestine and uterus. The denervated preparation of intestine and uterus was done by keeping in cold at 4°C for 24 hours; produces the same effect as with fresh preparation. It suggests that the aq. extract has direct effect on the plain muscle. Both intestine and uterus can be revived to normal after washing with ringer showing the effect is transitory.

61. Effect of Selenium Dioxide on Plain Muscle.

R. N. ROY and S. R. MAITRA, Calcutta.

Selenium dioxide in 0.5 mg. dose in 50 c.c. Dale's bath shows no marked effect on both the intestine and uterus. 1 mg. shows slight inhibitory effect but 2 mg. markedly inhibits the intestinal and uterine movement with relaxation. It regains to normal after washing with mammalian ringer. The same effect was noticed with uterine and intestinal muscle when they were denervated by keeping them in a refrigerator for more than 24 hours before the experiment.

62. Sensitization to potassium by Potassium Dichromate.

AJIT MAITI and AMAL ROY, Calcutta.

Various substances, unrelated to the actions on the muscles, have been identified to have a potentiating effect to potassium on the contractions of striated muscles. The action of potassium dichromate on the response of the striated muscles to potassium has been studied by means of toad's standard rectus abdominis preparation. The direct action of potassium dichromate on the response of striated muscles has been studied and it is found that potassium dichromate induced the shortening of the muscles when directly added to the bath. Potassium dichromate in the concentration of 1:2000 increased the response of the action of potassium chloride (1:1000) to the striated muscles and this increase is probably due to the sensitization of potassium ion of the muscle, as moderate changes in the potassium content of the Ringer's solution bathing the muscle is directly influenced by the previous treatment with potassium dichromate.

It has been suggested that the increased response of the muscle by direct stimulation (caused by potassium ion) induced by the addition of potassium dichromate appeared to be due to the action of the potassium component of the muscle which is influenced by potassium dichromate, though the exact mechanism is not clear.

63. Quinidine-like action of chlorpromazine on veratrine-response and auricular arrhythmias.

R. B. ARORA, V. N. SHARMA and B. R. MADAN, Jaipur.

In recent publications from this laboratory it was shown that substances which possess antiveratrinic property also exhibit antiarrhythmic activity. Since chlorpromazine is an antifibrillatory drug, it was of interest to see if it also exhibits anti-veratrinic action.

In its action on veratrine response, the drug showed a similarity of action to cinchona alkaloids, quinine and quinidine, in that, it was possible not only to abolish the fully developed veratrine response but also to prevent it by pretreatment of the muscle with appropriate concentration of the drug. The antagonistic action of quinine to veratrine response has led to its use in certain forms of human myotonia. Therefore chlorpromazine, which is stronger in its antiveratrinic action than quinine and quinidine, does seem to be a drug of possible therapeutic usefulness in myotonia.

Chlorpromazine was also shown to be fully equivalent to quinidine in experimental auricular flutter and acetyl-choline-induced auricular fibrillation. But, unlike quinidine, it failed to bring about the arbitrary 'end point' in aconitine-induced auricular fibrillation.

These findings shed more light on the parallelism that seems to exist between antiarrhythmic and antiveratrinic actions of the compounds, and it may be possible to find better substitutes for quinine in myotonia from among a large number of antiarrhythmic drugs.

64. A study on the relationship between the chemical structure and antiveratrinic property of cinchona bases and synthetic cupreines.

R. B. ARORA and P. C. DANDIYA, Jaipur.

The work was undertaken to establish the relationship between the chemical structure and antiveratrinic property of cinchona alkaloids, synthetic cupreines and some of the related compounds. The compounds selected for this study were epiquine, epicinchonine, quinuclidine, quinicine, lepidine, ethylether cupreine and propyl ether cupreine; quinine and quinidine were used as standard for comparison and the antiveratrinic action was determined on the sartorius muscle of frog suspended in twin chambers in bi-carbonate buffer solution. Supra maximal shocks (40 volts, duration 0.5 millisecond) were applied to the muscle in the bath fluid by a Grass Stimulator delivering square waves. In all experiments veratrine response was produced by veratridine 1:10,000,000.

It was revealed that changes in the steric configuration do not have any effect on the antiveratrinic property of these compounds. The presence of the quinoline ring is responsible for the antiveratrinic activity and quinuclidine ring has no importance in the determination of this property. Both the secondary alcoholic group and the vinyl group are important for the antiveratrinic property. Alkoxy substituents at the 6' carbon are the most significant, the activity increases with the increase in the size of the alkoxy radical.

65. The Antiveratrinic action of the chemical components of chloroquine and some other chlorine substituted compounds.

R. B. ARORA and P. C. DANDIYA, Jaipur.

The antiveratrinic activity of some of the cinchona alkaloids, synthetic cupreines and antimalarial drugs has been found to run parallel to their cardiac activity. Chloroquine has been found to be a promising anti-arrhythmic compound and hence it was thought desirable to locate the chemical configuration responsible for its antiveratrinic action and thus its anti-arrhythmic properties. The compounds selected for this study were 4-Amino-quinoline, 7-Chloro-quinoline, Di-ethylamine, 4-Diethyl amino-methyl 1-butylamine, deoxy-cinchonine, deoxy-cinchonidine, 9 chloro-deoxy cinchonine, 9 chloro-deoxy cinchonidine.

The experiments were done on the sartorius muscle of frog suspended in twinchambers in bi-carbonate buffer solution. Supra-maximal shocks (40 volts, duration 0.5 millisecond) were applied to the muscle in the bath fluid by a Grass Stimulator delivering square waves. Veratrine response was produced by Veratridine 1:10,000,000.

It was revealed that 7-Chloroquinoline possesses maximum antiveratrinic activity amongst chloroquine compounds and that chlorine substitution at 9' carbon of the cinchona compounds considerably enhances the antiveratrinic activity.

66. Anticholinergic action of chloroquine and camoquine on smooth and cardiac muscle.

R. B. ARORA and S. L. AGARWAL, Jaipur.

Experiments were conducted on the isolated intestinal, tracheal and cardiac muscle of the rabbit to study the anti-cholinergic activity of Chloroquine and Camoquin. Both these drugs in concentrations ranging from 1:200,000 to 1:50,000 inhibited spontaneous activity of the intestinal and cardiac muscles. On the tracheal chain, however, camoquin had a slow constricting action which was not shared by Chloroquine.

Chloroquine and Camoquin in concentrations ranging from 1:200,000 to 1:50,000 inhibited the responses to 1:5,000,000, 1:100,000,000; and 1:1,000,000 and 1:500,000 of acetylcholine on intestinal, tracheal and cardiac muscle respectively. Thus it was found that Chloroquine and Camoquin in addition to antiveratrinic and anti-arrhythmic actions (Arora, 1955, Arora, Sharma and Madan, 1955 and Arora and Madan, 1956 (to be published) Ind. Jour. Med. Res.) also possess antiacetylcholine action like Quinidine.

The concentrations in which these drugs under the present experimental condition exhibited parasympatholytic properties are much less than those achieved clinically, hence it is suggested that this anticholinergic property should be kept in mind during the therapeutic administration of these drugs particularly when intravenous route is adopted.

67. Antagonistic Action of Aq. Extract of *Symplocos Racemosa* (Beng.—Lodh) and Adrenaline on Toad's heart.

R. N. ROY and N. N. DAS, Calcutta.

After administration of 1 c.c. aq. extract in 1:10 dilution the heart showed slowness of beat, short amplitude and prolonged diastole. In this condition no marked effect was noted by administration of 0.5 c.c. adrenaline in 1:100,000 dilution. After administration of the same dose of adrenaline and during the active phase of its action, introduction of 1 c.c. of extract in 1:10 dilution caused inhibition of action of adrenaline. Administration of adrenaline and aq. extract mixture, the predominance of action of aq. extract was noted.

68. Mechanism of Action of Selenium on Toad's heart.

R. N. ROY and S. R. MAITRA, Calcutta.

Action of Selenium dioxide on toad's heart was investigated. It has been shown that 0.05 mg. has no marked effect but 0.1 mg. 0.2 mg. slows the rate and decreases the amplitude of the heart which regains to normal as soon as it is washed with Ringer soln. 0.3 mg. completely stops the heart in diastole and continuous washing

for few minutes with Ringer is required to bring it to normal. Vagus stimulation does not change the nature of action of Selenium on heart. Action of Selenium still persists when it is applied after the perfusion of heart with atropine and Nicotine which paralyses the vagal endings. Conclusion has been drawn that inhibitory action of Selenium is directly on the myocardium.

69. Effect of liver extract on adrenaline induced fatty liver.

(Mrs.) A. CHATTERJI, M. L. CHATTERJEE and H. F. HANSLER.

It has been repeatedly shown that injection of adrenaline to normal rats produce fatty infiltration of the liver and also increase the weight of the adrenal glands. But adrenalectomised rats do not show this fatty infiltration. It has also been shown that fatty infiltration of the liver resulting from partial hepatectomy is inhibited by injections of liver extract. Fatty infiltration of the liver has been produced in normal young rats by subcutaneous administration of adrenaline over a prolonged period. Simultaneous administration of injection of liver extract inhibits this fatty infiltration. Probable role of adrenaline and liver extract in fat metabolism is discussed.

70. Pharmacological action of *Rauwolfia serpentina* Benth on two isolated tissues.

M. L. CHATTERJEE, Calcutta.

There are divergent and even contrary views about the effects of the alkaloids of *Rauwolfia Serpentina* Benth. (R.S.) on the action of acetylcholine (Ach) and Adrenaline (Adr.) on intact animals. There is a difference of opinion also regarding the mechanism of action of R. S. itself e.g., about its role on vagal mechanism and its action on intestinal activity. In order to find an explanation of and the true nature of action of R.S., and further to study the effect of the presence of R.S. on the action of Ach. and Adr., experiments were carried on isolated tissues—viz., auricles of heart, and duodenum of rabbits, since in the study for the above, including that for mechanism of action or antagonism which may exist between two drugs, isolated tissues are more informative.

The present investigation finds that the action of R.S. is not cholinergic, at least on the isolated auricles, and its effect on the action of Adr. on this tissue is to cause a slight potentiation of the amplitude with such a low concentrations as 5×10^{-8} g/ml. and a depression, with higher concentrations like 5×10^{-5} g/ml. or more. The lower concentration like 5×10^{-6} g/ml. does not appreciably modify the rate which, however, is reduced with higher concentrations. Furthermore, the action of Ach. is more effectively antagonised or reduced by R. S. compared to that of Adr.

The action of Adr. to relax the tone of an isolated piece of duodenum appears to be reduced to some degree by the presence of R.S., especially when the latter is present continuously and its concentration is gradually increased which by itself relaxes the tone of the muscles and alters the character of response of the tissue.

71. Study on the mechanism of action of Penicillin on the retardation of metamorphosis of tadpoles.

A. K. MEDDA, G. C. BHATTACHARYA and P. N. NANDI, Calcutta.

It has been reported that the metamorphosis of tadpoles (*Rana tigrina*) treated with penicillin solution is delayed or retarded from two to four months or more

and even it has been noticed that some tadpoles remain in the larval stage for about one year; whereas the controls develop into froglets within the usual time. These retarded tadpoles, after treatment with vitamin B₁₂ solution, metamorphosed within about 10 days. The present investigation has been undertaken with the object of finding out the mechanism of action of penicillin on the retardation of metamorphosis of tadpoles by isolating the bacteria from the intestine and studying their ability to produce vitamin B₁₂. The bacteria mostly gram positive were isolated from the intestine of these animals by plate cultures using nutrient agar as the suitable medium. Of them the gram positive bacillus, gram variable bacillus and gram positive coccus (red colony) synthesized vitamin B₁₂ in suitable medium. Those bacteria are penicillin susceptible. The bacteria isolated from penicillin treated tadpoles do not produce vitamin B₁₂. It is evident, therefore, that the metamorphosis-retarding action of penicillin is indirect and due to its inhibitory action on the growth of these vitamin B₁₂ producing bacteria in the intestine of these young animals, this vitamin becomes deficient in the system of these larvae. It seems for this deficiency the metamorphosis was delayed or retarded.

72. Antihistaminics in the Treatment of Uraemia in Cholera.

HEMENDRA NATH CHATTERJEE, Calcutta . .

In a series of 105 cases of cholera during the 1954 epidemic with total suppression of urine of more than 5 hours' duration, the effect of three different antihistaminics (including controls) were tried to find out their action regarding the onset of urination and relief of uraemic symptoms. A control group was also studied. Of these only 55 cases gave positive stool culture in either or both of two consecutive examinations. Anthisan failed to start urination in 3 out of 11 culture positive cases tried (27.2%); Largactil failed in 2 out of 11 of these culture positive cases (18.1%) and Phenergan in 1 out of the 17 cases (5.9%). In the control group there was no urination in 4 cases out of 16 culture positive cases (25%).

The average time for the starting of the urination after the last injection were: Anthisan 12 hours; Largactil 10 hours; Phenergan 9 hours. In the control group the average time of urination was 24 hours after starting of the usual saline treatment in those cases where urinary function started.

Anthisan alone (without Vitamin C) showed no special advantage over the control cases so far as the number of the cured were concerned, although the average time for the onset of urination was somewhat shorter. Largactil was found to have a special drawback in cholera cases as it induced a dangerous depression of blood pressure. Consequently the observations were not continued beyond 20 cases with each of the latter two drugs.

Phenergan seemed to be of definite help both regarding mortality rate and the earlier onset of urination. No untoward reactions were observed in the 17 culture positive cases. There was a failure of urination in one case out of 17 cases and a combined treatment with intravenous Vitamin C and Phenergan intramuscularly in the back is suggested following writer's previous work (1952).

This suggestion has been actually worked out in the epidemic of 1955.

Following the above combined method of administering Phenergan intramuscularly in the kidney region and Vitamin C intravenously. There has not been a single case of uraemia with suppression of urine amongst a group of 227 cases of clinical cholera in 1955 during the months of April and May in the writer's ward.

73. The effect produced by the green leaves of *Ficus bengalensis* on the isolated intestines.

A. CHATTERJEE, S. B. CHOWDHURY and D. P. SADHU, Calcutta.

During the course of studies on the pharmacology of indigenous plants, the effects produced by the green leaves of *Ficus bengalensis* on the isolated intestines were studied in our laboratory. It is often a common practice amongst the villagers to feed their animals with the green leaves of *Ficus bengalensis* and *Bambusa tulda* in cases of certain intestinal disorders. Under the present studies, the effect produced by the leaves of the former plant has only been studied.

The leaves were cut to pieces, minced in an electric mincer and the effect of the crude juice was studied on isolated intestines of Rats in a Dale's Isolated Organ Apparatus. With varying doses from 1 ml. to 6 ml. no effect of any pharmacological significance were observed.

74. The effect produced by the green leaves of *Bambusa tulda* on the isolated intestines.

A. CHATTERJEE, S. B. CHOWDHURY and D. P. SADHU, Calcutta.

During the course of studies on the pharmacology of indigenous plants, the effect produced by the green leaves of *Bambusa tulda* on the isolated intestines of goats and rats were studied.

Leaves of *Bambusa tulda* were cut to pieces and minced in an electric mincer. The juice was then strained through muslin. The effect produced by the crude juice on isolated intestines was studied in a Dale's Isolated Organ Apparatus. A dose of 0.5 ml. (in 120 ml. of Ringer's sol) marked stimulation of the movements. The pharmacological significance of the drug has been discussed in this paper.

75. The effect produced by the crude juice of *Ficus bengalensis* on the uterus of virgin rats.

A. CHATTERJEE, S. B. CHOWDHURY and D. P. SADHU, Calcutta.

During the course of studies on the pharmacology of indigenous plants, the effects produced by the crude juice of the green leaves of *Ficus bengalensis* were studied on the uterine movements of virgin rats. It is a common practice amongst the villagers to administer green leaves of the plant in certain uterine disorders. The object of this present study was to evaluate the efficiency and pharmacological significance of the treatment.

Leaves of *Ficus bengalensis* were cut to pieces and minced in an electric mincer. The effect of the juice was studied on the uterine horns of virgin rats in a Dale's Isolated Organ Apparatus. A dose of 4.0 ml. (in 120 ml. of Ringer's solution) inhibited the movements, but the time required to produce the effect was quite long. The pharmacological significance of the drug has been discussed.

76. Lack of Agreement in the Results of Assay of Lanatoside Preparations by the Chemical and Biological methods.

B. N. CHOWDHURI, S. C. BHUTTACHARYA and M. D. CHAKRAVARTI,
Calcutta.

Chemical method of assay of lanatoside preparations (lanatoside C and lanatoside A, B and C) fails to indicate true biological potency as determined by the biological methods. While there is agreement in the two results in case of samples

freshly prepared having full biological activity, fall of biological potency due to some reasons or other is not detected by the chemical method. It appears that the chemical methods at present in use for the assay of digitalis glycosides lack in specificity, since slight changes in composition etc. of these preparations altering their biological activity are not detected by these methods.

MISCELLANEOUS

77. Rate of Oxygen Consumption in *Paramphistomum explanatum* and *Gastrothylax crumenifer*.

M. M. GOIL, Bareilly.

The rate of oxygen consumption of these two endoparasites *Paramphistomum explanatum* and *Gastrothylax crumenifer* collected respectively from bile ducts and rumen of common Indian water buffaloes was measured by Warburg Apparatus. It was found that the rate of Oxygen Consumption (QO₂) in *Paramphistomum* sp. ranged from—0.842 to 1.34 microlitres per milligram dry weight per hour whereas in *Gastrothylax* it ranged from —0.393 to—0.331. The investigations on the respiratory metabolism in helminths by Lazarus (1950) show that the pattern of respiratory metabolism may vary even among morphologically related forms. He had studied the rate in *P. Cervi* and found a low QO₂, i.e., —0.03 in this species. The higher values for QO₂ observed in *P. explanatum* in the present investigations might have been due to the fact that these helminths were collected from the bile ducts whereas *P. Cervi* was collected by Lazarus from the reticulum. Further, it is seen that *Gastrothylax* inhabiting the rumen, where bacterial fermentation is active has less QO₂ than *P. explanatum* which inhabits liver and bile ducts where bacterial fermentation is almost negligible.

78. A Preliminary Study of the Co-relation of Nuclear Ratio of Cancer cells in Culture and Biopsy.

JYOTIRMOY CHATTERJEE and REBATI DUTT CHAUDHURI, Calcutta.

Material was collected from Cancer cervix cases (3rd stage) by a punch forceps and one part of it was used for tissue culture and the other part was fixed, sectioned and stained in the usual way. The culture was done on Maximow's depression slide using (1) patients' serum, (2) patients' plasma (3) chick embryos extract containing 50% Tyrode solution as medium.

3 to 5 day old culture was smeared and stained with Haematoxylin Eosin. The cells from these stained preparations were drawn by camera lucida and were compared with similarly drawn cells from the sectioned and stained biopsy material.

As will be expected the tissue culture cells being free floating in a semifluid medium will have a digerent cell size and unclear size. But contrary to the expectation we find that the cell size, unclear size and unclear cytoplasmic ratio of these two types of preparation have a high co-relation.

79. Histopathological Study in Experimental Nephrosis.

SAILEN MOOKERJEA, Nagpur.

Antisera against rat kidneys were prepared by injecting suspensions of perfused rat kidneys into rabbits according to the method of Heymann.

Nephrotoxic sera obtained from rabbits were intravenously injected into rats, thereby causing dramatic development of nephrosis as indicated by excessive albuminuria and increase in cholesterol values.

Blood and kidney cholesterol showed a great rise. Microphotographs of the histological preparations revealed the characteristic hydropic degenerative changes in tubules of the kidney. Many of the glomeruli also showed degeneration, distended capsular spaces and swelling of capillary walls.

80. Enzymatic Dissection of Skin.

BAL KRISHNA and M. SREENIVASAYA, Lucknow.

In connection with our work on enzyme systems associated with the Skin, we have made a study of the distribution and nature of the proteins of the skin. Black and white samples of skin were obtained from the ear lobes of a guinea pig which had both types of patches. 10 to 15 μ thick sections of the tissue were obtained both by the method of freeze drying and paraffin embedding.

The sections were then examined by the method of what is generally known as enzymatic dissection. By the use of integrally pure enzymes, it has been found possible to hydrolyse out that tissue component—glycogen or protein—for which the enzyme is specific. Pepsin, papain and trypsin have been separately employed and the degree of hydrolysis as also the site of action, have been determined by staining the sections before and after hydrolysis with ninhydrin and Millon reagent. Among the significant differences are (1) the intercellular amorphous proteins present in the epidermis are hydrolysed away leaving the fibrillar structure relatively in tact. (2) The corresponding proteins of the black skin appear to be relatively more resistant to the action of the enzymes, (3) Support to this finding is lent by the results of a chromatographic study of the enzymatic digests of white and black skins. Greater quantities of amina acids are found in the white skin digest. (4) The melanin granues present in the black skin are unaffected by any of the enzymes employed.

81. Folic Acid Dehydrogenase in Blood.

BEATRIZ M. BRAGANCA and U. W. KENKARE, Parel, Bombay.

Blood and some other tissues have been found to contain an enzyme which actively degrades Folic Acid at the junction between the Pteridine moiety and p-Aminobenzoic acid portion of the molecule. The enzyme has been found to be soluble and active at low Ph conditions. Evidence is presented to show that the products of reaction are Pteridine—6 aldehyde and p-Aminobenzoic acid derivatives of Folic acid. Studies relating to the properties and specificity of the system indicate that the cleavage of Folic acid by this enzyme system involves an enzymic dehydrogenation followed by spontaneous hydrolysis of the intermediate imino compound formed. The possible role of this enzyme system in intermediary metabolism of Folic acid in animal tissues with special reference to growth processes will be discussed.

SECTION OF PSYCHOLOGY AND EDUCATIONAL SCIENCES

President :—SHRI L. J. BHATT, M.A., B.T. (Bom.), M.A. (Leeds).

Abstracts

1. Learning and Retention of an Isolated Number on the Background of Meaningful Material.

V. K. KOTHURKAR, Poona.

The aim of the present study is to see how the similarity and dissimilarity relations operate within meaningful material, using some Bartlett's methods of realistic memory experiments. The experiment was undertaken to see if the advantage of the isolated element persists even if it is embedded in meaningful material.

From the data we see that there is still some advantage, though not quite so large as in the case of discrete, non-sense material, for the isolated item over the cumulated items even of a meaningful character. Why this fall in advantage of the dissimilar isolated element? Some explanations are discussed and the following is proposed as the most plausible. The dissimilar is the discriminable and hence its advantage in learning. The gap of difference is wider in the Rostorff type of material than in the Bartlettian substance passages and hence smaller difference in recall scores.

By way of a provisional conclusion of this experiment, I believe, it may be said that an isolated number does not possess that degree of advantage on the meaningful background which it has in the rote serial learning of a list of non-sense syllables.

2. The Effect of Diversification of Serial Materials on the Bow-shaped error-Function.

V. K. KOTHURKAR, Poona.

The aim of the present experiment was to see how specified systematic diversification of the types of materials in a serial list affect the shape of the positional error-function. The experiment was designed with four 10-item lists of different degrees of diversity.

List A—presumably the most homogeneous—contained 10 nonsense syllables, all written in black capital letters. List B contained 5 nonsense syllables in red ink and 5 in black ink, all with capital letters. There was only one principle of intraserial differentiation viz. colour. List C was constructed with five different types of materials and in list D each item was intended to be different from every other item.

The four lists were presented individually to each subject on four consecutive days, on a memory drum with the two-seconds procedure. Serial anticipation method was used and the criterion of mastery was one correct recitation in perfect order. The results given are averages of 20 subjects.

If a single nonsense syllable of a series is written in red ink, errors are reduced at that locus. If however, the proportion of black and red syllables is equal, as in series B of this experiment, the advantage does not appear to be there. The usual bow-shape does not appear to be depressed at any of these (red) points. In series C there is a considerable reduction in the average number of trials. List D

which is still more diversified shows less saving in trials than list C though it also makes considerably fewer trials than either A or B. In series C with five different types of materials, the error-curve is considerably warped by reduced errors at and around the numerals and meaningful words. It is suggested that any arrangement of the C type of items would yield a more level curve than the usual error-function. Under D conditions also the error-curve is much depressed though not to the extent of the C series.

Tentative conclusions :—Equal red-black diversification does not change the shape of the error-curve nor does it depress it generally. Greater diversification changes the shape and depresses the curve upto a point reached in series C, within the limits of this experiment, beyond which the error-score seems to rise again.

Is 'Illusion' illusion?

NIROD MUKHERJI, Gauhati.

This experiment forms a component part of an investigation planned to examine the possibilities of constructing a theory of perception including illusions. The reason for giving priority to the latter is that these constitute the main hinderance against the constructing of a composite hypothesis to explain perception.

In the present series of experiments Muller-Lyer figures were used. The figure with its obliques directed inwards (P) was used as the standard against which was to be equalized the figure with its obliques directed outwards (Q). Colour of the stimulus was uniformly black; so was the central line of the variable, but its obliques bore different hue for three sets of experiments. In the first set (a) the obliques were of dark colour, in the next set (b) green, and in (c) red. The problem was to see whether the difference in the colour of the obliques made any substantial difference in the magnitude of error.

Records of twenty subjects of homogenous character were treated for F-test. A significant difference was obtained.

Theoretical discussion to explain the difference follows.

4. An investigation into the Time Perception and Reaction Times.

R. G. CHATTERJEE, Calcutta.

The paper reports the results of temporal intervals and reaction times of ten subjects. Four standard times of 2.0, 1.0, 1.5 and 0.5 seconds were presented, and the motor, sensory, discriminative and choice reaction times were recorded. In the interval experiment the mean estimations found were 1.77, 0.98, 1.37 and 0.58 seconds. The mean figures for the different reaction times were : motor 185, sensorial 288, discriminative 370, and choice 423. Each subject in the RT experiment were given 50 to 100 trials. The coefficient of correlation between CE and RT shows significant trends. The CE at 2.0 and SRT give a coefficient of -0.68 while CE at 1.5 and SRT show a still higher value, -0.72 . The values of r are high in standard time 0.5 viz., -0.71 , $+0.50$ and $+0.65$. Very little relationship appears to exist between CE's and discriminative reaction time. The coefficients have been negative in CE at 1.5 and all the four types of reaction times.

5. The Estimations of Intervals in Qualitatively Different Stimulus.

R. G. CHATTERJEE, Calcutta.

Three subjects were given three standard times of 1.5, 1.0 and 0.5 seconds for 100 times each. In one presentation the intervals were bound by two mild pressures

—the pressures being put on a point on the left forearm of the subject. In another, the intervals were bound by two lights of mild intensity, while in a third, the mode of presentation of the intervals was done by two clicks (sound). The mean of 100 trials of each subject at each standard time was calculated. The group mean shows the figures at 1.5 interval as 1.087, 1.19 and 1.241 for pressure, light and sound respectively, at 1.0 interval, .942 (pressure), .953 (light) and .913 (sound) and at .05 time, .548 (pressure), .558 (light) and .579 (sound). The longer intervals of 1.5 and 1.0 have been underestimated while the small interval of 0.5 has been overestimated by all the subjects irrespective of mode of presentation.

6. Role of Affectivity in Perceptual Judgment.

DURGANAND SINHA and NIKHILESH KUMAR SINHA, Patna.

An experiment was designed to study how far liking or disliking an object influenced its perception. After a preliminary test on 60 students, and using the X^2 -method, 15 photographs of unknown faces were selected from a lot of 60. These were found to possess roughly equal chance of eliciting like- or dislike-judgments.

Fifty college students were asked to indicate their likes and dislikes for each photograph. Later on they were requested to assess height, weight, and certain psychological characteristics (e.g. honesty, generosity and intelligence) of the individuals in each one of the photographs.

Comparing the assessments of these qualities it was found that liking a photograph significantly affected the judgment of height and the three psychological traits. Height of individuals in a photograph when liked was consistently estimated more than when it was disliked. Similar tendency was not, however, seen with regard to judgment of weight. There was, on the other hand, very marked difference with regard to the judgment of three psychological qualities. Most of the differences were found significant by t-test. It is concluded that liking or disliking an object greatly influences the attribution of physical and psychological qualities to that object. The accentuation is greater in case of qualities which are socially valued.

7. A Study of Individual Differences in Monotony Susceptibility.

ZAFAR AHMAD SIDDIQI and JAMIL QADRI, Aligarh.

Subjectively speaking monotony is the feeling of boredom and tension accompanying a repetitive task ; objectively it is manifested by an increased variability in the rate of work.

The present study was made with a view to finding out individual differences in monotony susceptibility.

A group test was devised for this purpose and it was given to two groups of males and females, of 25 members each. The analysis of the data, while throwing light on significant individual differences, also brings out important correlations in monotony and fatigue, in speed of work and time-estimation etc.

The findings of the group test were also checked and verified by the two apparatuses (Siddiqi's Monotony Apparatus and Siddiqi's Monotony Recorder) specially devised for the purpose.

The significance of the study lies in the fact that much of inefficiency and maladjustment in industry can be spared if we are able to determine monotony susceptibility of individuals beforehand and avoid highly monotony-susceptible individuals in the selection for repetitive jobs,

8. Reminiscence of Geometrical Designs.

T. P. LELE, L. J. BHATT and M. M. PATEL, Baroda.

Generally, the standard retention curves indicate a rapid fall immediately after learning a particular task or activity, unless and until the task has been over-learned or reviewed. Under certain conditions, however, the curve of retention shows a reversal ; the amount retained at first increases as a function of time and then decreases in the usual manner. Such a temporary improvement in the performance occurring without the benefit of practice is known as "Reminiscence."

An experiment was conducted to study reminiscence of geometrical designs. Twenty geometrical designs were selected for the experiment. The subjects were school children from nine different schools of Baroda, studying in the IX Class. All the geometrical designs were exposed only once, each being presented for two seconds. Two recall scores were taken : one immediately after learning and another after intervals of half an hour, one hour, two hours, three hours, four hours, one day, two days, three days, and four days. In no case children were given any idea that they would be re-tested after a definite interval. The age of the children and teachers' estimates about their intellectual level were recorded. From the analysis of the results, the following conclusions are drawn :

- (1) Reminiscence is seen when the learning material is in the form of geometrical designs.
- (2) Reminiscence of geometrical designs is more apparent in the case of dull children than in the case of brighter ones.
- (3) The older children show more reminiscence of geometrical designs than the younger ones.
- (4) Reminiscence is not evidenced when the interval is short.

9. Multiple Choice, Microchronometer, and some other Psychological Apparatus.

K. P. BHAGAT, Poona.

In continuation of my paper entitled 'Some Important Psychological Apparatus' submitted last year, I wish to mention here some additional items manufactured locally.

Modification of Yerkes' Multiple Choice Apparatus : Instead of the keys lighted neons are presented to the subject and he presses a special toggle switch placed below each neon instead of pressing the key as in the old models. Works on 220 volts A.C. or D.C.

Microchronometer : Measures time to 1/2000 or 1/5000 of a minute. Works on 220 volts, A.C. 50 cycles.

Electronic Voice Key : Slightly modified version of the one suggested by DeSilva and Jacobson. Works on 220 volts A.C.

Electronic Time Clock : An interval of 1, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{1}{5}$ second can be marked on a kymograph by means of this timer. Works on 220 volts, A.C.

Electronic Memory Drum : Exposure time is controlled by a continuously-acting electronic timer. Works on 220 volts, A.C.

Electronic Tachistoscope : A Dodge tachistoscope as modified by Kupperian and Golin, but with card-holders and the observer's hood as suggested by Merryman and Allen. The exposure time to be controlled by an electronic 'Single-Stroke Photographic Timer'; working on 220 volts, A.C.; giving minimum exposure of 20 milliseconds.

10. Development of a New Edge-marking Method for Psychological uses.

SUSHIL KUMAR, Calcutta.

For item analysis on large scale we can use IBM machines, but for small scale testing analysis tabulation etc. are employed. As tabulation puts limitation (due to time and labour) on the sample which is taken for item analysis, the results are not very accurate. Thurstone's edge marking method has been used extensively in U.S.A. The said method is explained in the paper with the improvements made at Indian Statistical Institute. Instead of his printed card the blank cards have been used with a board for marking them, which makes item analysis easier, quicker, and cheaper.

11. Machine Scoring of Objective Tests.

SIBABRATA CHATTERJEE, Calcutta.

This paper describes a method for scoring tests, using IBM punch card equipment. Not only is the method a great saviour of time but it has also the great advantages in accurate scoring, tabulating and making necessary statistical calculations. When such work is done with unerring precision by automatic calculating machines the best of human efforts cannot match it either in speed or in accuracy. Various special advantages of machine scoring will be discussed.

12. The Application of Factor-Analysis to Problems of Learning.

BISHWA NATH MUKHERJEE, Patna.

The first application of factor analysis to learning data was made by Per (1934) to test Spearman's Two-Factor theory. Subsequent investigations particularly by Woodrow, Husband etc. were undertaken with the same aim. Both Woodrow and Husband found in their number of studies that there exists no general learning ability. Gain in scores with successive practice was found to correlate highly with specific and group factors which were however not unique to learning. Moreover, they also found no evidence to identify 'intelligence' with our ability to learn.

The most important thing found in Woodrow's factor—analytic studies however concerns the change of the importance of different abilities with practice. Change in the factor patterns with successive practice shows that the factors influencing our learning are not static. This was confirmed in the animal domain by Wherry (1939). His researches suggest that a certain factor (which accounts for performance of a few trials when it is dominant) may be relatively unimportant in a latter part of the learning situation (when another factor is dominant).

In spite of its many flaws, Factor analysis can now test many such hypotheses. By means of factor analysis, we can not only separate the effects of various factors influencing learning and study their rise and wane but also determine whether there really occurs 'insight', how our motives play a significant role, are there more than one kind of learning as Tolman now says and questions of these sorts which have a direct bearing on the nature of the learning process. Factor-analytic studies of this type may overcome many of the difficulties that are usually met in the study of human learning by controlled experiments. Factors emerging from such a study are likely to contribute to a reformulation of a learning theory.

13. The Validity of a Medical College Selection Programme.

MRS. NAOMI CARMAN, Vellore, A. EDWIN HARPER, Jr., and
S. P. SANGAL, Calcutta.

The Christian Medical College at Vellore has had an extensive programme of selection tests, since 1946. They were originally set up by Dr. Frank Lake, and based on his experience with selections of officers in the British Army. At the first stage, over five hundred candidates appear in some twenty centers in India and neighbouring countries. Six objective tests of knowledge and ability are administered, and one essay test. About eighty of the best candidates are then called to Vellore, for two days of "situational tests", physical examinations, and other assessment procedures. The fifty available seats in the College are filled with the best of these applicants. Validity studies have been proceeding for some time, and have shown good results. For example, students selected by these tests fail only half as many papers as those selected, prior to 1946, on the basis of Intermediate Division and such traditional criteria. Uncorrected validity coefficients for individual tests and procedures range from .2 to over .5; when corrected for restriction of range, the coefficients are considerably higher. (Full graphs and tables will either be projected from film, or otherwise reproduced to show to the Session.)

14. Some Aspects of the Problem of Validity study in Selection Programme.

S. P. SANGAL, Calcutta.

In most selection programme, the number of candidates available for validity study has been restricted by the selection procedure. Thorndike and Gulliksen adapted Karl Pearson formula for psychometric problems. (See Thorndike "Personnel Selection", pp. 169-176). It seems that the method assumes a rigid selection that those above a certain score are accepted and others rejected. This paper attempts to show that the formulae are valid even if the selection is not so rigid, provided the procedure does not violate the following two assumptions:—

- (1) The regression line is the same for the two groups.
- (2) The variances of Y for a given X is the same for all Xs for the two groups.

Tables and graphs are presented to facilitate the computation of the corrected correlations.

15. Measuring Personality Patterns for Engineering and Medicine.

S. P. GHOSH, Delhi

This paper presents an attempt of the author for measuring personality patterns from a common battery of tests and inventories for some vocations in general, and for engineering and medicine in 'specific'. The personality patterns in engineering and medicine have been analysed by the method of general observation. The battery of tests and inventories for measuring these patterns includes the following:

- (i) One test of general abstract intelligence (Terman and Merrill form 'M' for group administration).
- (ii) Two tests of concrete intelligence—Dr. G. Bose's group Passalong and group Kohs' Block design adapted by CBEVG.
- (iii) Two special aptitude tests—a mechanical aptitude test (paper-pencil type) devised by CBEVG, and Crockett manual aptitude test.

- (iv) Two personality tests : Dr. G. Bose's Personality Inventory, and Bernreuter Personality Inventory adapted by Indian Statistical Institute.
- (v) Thurstone's interest inventory adapted by CBEVG.
- (vi) Interview Blank.
- (vii) School marks.
- (viii) Medical report.

The author recognises that the above procedure is only a screening one. Our guidance will be more perfect as more specific trade tests we will have.

16. Intellectual Abilities of 'Dublas'.

Prof. T. K. N. MENON, Mr. T. P. LELE and Mr. J. A. BHAGATWALA,
Baroda.

Dublas are natives of a part of Surat District in the Bombay State. This backward community is leading a life of serfs for many centuries. They have no independent life. They work either in fields as labourers or in houses as servants or anywhere their masters want them to work. The result of this is that their life is no better than that of animals.

This investigation is carried out with a special object of finding out whether "Dublas" a backward community leading the life of serfs in Surat District is inherently intellectually inferior.

The tests used in this investigation are the three performance tests (1) Koh's Block Design Test, (2) Alexander's Passalong Test and (3) Goddard Form Board Test.

As a result of a large scale survey the following conclusions are drawn :

- (1) Those who are attending the schools score more than those who do not.
- (2) The mean I.Q. decreases as the chronological age increases.
- (3) The performance on Passalong Test is superior to the performance on Koh's Block Design Test.
- (4) The mean scores of Dubla children who are attending the schools are nearly the same as the mean scores of children coming from other communities. This shows that 'Dublas' are not inherently intellectually inferior.

17. Attitudes of University students towards some Socio-cultural and Educational Issues.

DR. R. RATH, Cuttack.

In this investigation attempts were made to measure the attitudes of University students towards 12 socio-cultural and educational issues. Each questionnaire was arranged on a five point scale beginning from most favourable to most unfavourable views with an undecided middle. About 800 students were tested. The distribution arranged on a five-point scale showed a significant trend of attitudes because the Chi-squares for these distributions were highly significant. There was a clear evidence for well formed attitudes for all the issues studied here. The scores were also graphically presented by means of histograms and a detailed study of shapes and social implications of such curves was attempted.

The subjects were grouped separately under three occupational heads such as cultivation, business and services and three economic heads representing three distinct economic strata. In determining this the occupation and economic status of their families were taken into consideration. Occupation of families do not seem to have any influence on the attitude of students in regard to 9 of these issues.

But when arranged according to family economic status distribution of scores for 7 issues were randomly distributed.

18. A psychological study of the social values of some aspects of human conduct on the basis of opinions of the adult college students.

ASOKE KUMAR BOSE and K. C. MUKHERJI, Calcutta.

In this work an attempt has been made to find out the average opinion of the adult college students both male and female about the various aspects of human conduct. A questionnaire was prepared for the collection of opinions regarding sexual relation, murder and homicide, stealing, lying etc. A comparative study was made of the opinions given by the male and female students. It has been observed that the females are more ego-centric and individualistic in their judgment of values whereas the males are more social, altruistic and less ego-centric.

19. A Study of the relation between Stereotypes and Social Distance.

ANWAR ANSARI, Aligarh.

The study which was carried out with the help of some postgraduate Hindu and Muslim students of the Department of Philosophy and Psychology, Muslim University, Aligarh, who collected the data from their respective communities, was mainly intended to verify the following hypothesis :

Stereotyped or false perception of certain characteristics in the members of one communal group by those of another is functionally related to the social distance at which the former are held by the latter.

The experiment on which the study is based was conducted in three parts in the following order :

(i) Two sets of unfavourable standard stereotypes associated respectively with Muslims and Hindus, together with certain innocent and favourable epithets in each set, were presented to subjects of varied socio-economic backgrounds in the two communal groups, and the subjects were asked to check from among the communal groups (Hindus, Sikhs, Christians, Muslims and Parsis), provided against each epithet, the one to which the epithet was most applicable;

(ii) A modified form of Bogardus' Social Distance Scale was given to the subjects to show on it the extent to which they would like to have intimate, or distant relations with the members of each of the afore-mentioned communal groups;

(iii) Hindu and Muslim subjects were asked to write down briefly what they thought and felt about each other.

The results, particularly the positive and significant correlation between the frequency with which the standard stereotypes are used and the degree of the social distance shown by the members of one communal group for those of the other, confirm the hypothesis. The results are further interpreted, wherever possible, in the light of the impressions given by the subjects regarding the members of the other group.

20. Leadership Testing in Students.

DURGANAND SINHA and SACHITA KUMAR SINHA, Patna.

As a part of a larger project sponsored by the Government of Bihar to study the "reaction of students to the National Cadet Corps, and its influence on the development of character and personality", a comparative study of leadership

qualities in cadets and non-cadets was made. A paper-and-pencil test of leadership of the inventory type was constructed. Ninety-four statements were framed pertaining to tactfulness, adventure, dominance, sociability, self-confidence, initiative and broadmindedness. These were regarded as essential ingredients of leadership as they were found to be frequently included in their characterization of leadership by persons eminent in military and professional fields, as also the psychologists. Each one of these traits was specified, and working definitions prepared which were utilised at the time of getting assessment from judges and framing of tests.

A panel of 30 judges consisting of 15 military officers and 15 university teachers assessed how far these statements measured leadership qualities. Items on which there was less than 95% agreement were eliminated, leaving 70 statements for the final test. There were ten statements pertaining to each of the qualities listed earlier. On the basis of judges' assessment the various alternative answers to each statement was assigned a diagnostic score. The test was given to sixty male cadets and sixty students belonging to the B.A. classes. They were also rated on the seven qualities on a three-point scale by judges who intimately knew them. This was used as the criterion for finding out the validity of the test.

The split-half reliability of the test was calculated, and the co-efficients varied from .74 to .85 for each one of the sub-tests, and was .80 for the whole test. The validity was assessed by co-relating the test-score with the assessment score. These co-efficients ranged from .51 to .67 indicating that the test measured the qualities which it supposed to do. Phi-coefficients were calculated to study the inter-connections between each sub-test. These ranged from .51 to .83. The high value of co-efficients indicated that there was a common factor underlying the qualities measured by the sub-tests.

21. An Experimental Project to reduce Inter-caste Tension in an Indian Village.

R. P. N. SINGH, Patna.

The study was conducted under the UNESCO Tension Research Project at the Institute of Psychological Research and Service, Patna University centre, under the guidance of Dr. G. Murphy and Prof. H. P. Maiti. In the present study Inter-caste tension was sought to be reduced by Action Research programme keeping in view the significance of the phenomenon. After a careful survey of a number of villages, a village in the district of Patna was picked out to be the most suitable village for the study keeping in view the economic condition, population, location, social status etc. Two backward classes Hindu Sub-caste groups, viz., Kurmis and Gowalas were having conflict against each other.

The study started with the Hypotheses that the village unit is divided into two poles without a barrier but with a strong antagonistic attitude towards each other. A third pole, unique in nature, unlike their stereotypes, was created in the form of a play school. It was expected that the third pole will redistribute the energetic aggressive or otherwise and identification with their children and mutual contact of the adults (Williams-S.S.R.C. 57-1947) will tend to reduce tension.

In order to judge the effects of the Action programme it was necessary to measure their attitudes before and after the programme. As the group consisted of illiterates Open-end interview technique was used, in which the investigator was specially trained. After assessing the attitudes, the Action programme was introduced. In the play school all the play materials were furnished by the investigator along with other incentives for attracting the children. Twenty such play sessions were held in course of five months. In the games played there, special care was taken to divide the children into two mixed groups. When the number of spectators grew larger, then a game of adults was also introduced, which ended with the slogans like 'Kurmi Gowala Ek hain'. The post action attitude were measured at

it was found that the third pole does really redistribute the forces aggressive or otherwise and brought the adults of the two groups together for constructing a dam for common benefit of the villagers. It was also found that the cause of tension is not a group or a community but a few individuals, who like hysterics, derive pleasure in keeping the groups against each other.

22. On Item Difficulties of a Scholastic Achievement test.

S. D. DUBEY, Kharagpur.

In this paper an attempt has been made to find a suitable difficulty index of question items of a scholastic test, keeping in view some typical problems arising out of an analysis of a Public Examination Question Paper in Mathematics. Available methods provide for application only in cases where item responses are classified to be belonging to failure or success group for which scores of respectively zero and unity are allotted. The formula obtained here is suitable not only for cases of responses admitting intermediate scores between zero and maximum marks for a question-item but also for the above case of 0 (failure) and 1 (success) scores on the same. A somewhat different definition other than that cited in the literature is given and the justification for its adoption has been put forward. The expression for standard error has been obtained and utilised in cases of the items of the Question Paper referred to above.

23. On the Determination of Weights for Different Branches of High School Mathematics.

A. K. GAYEN, Kharagpur.

In allotting weights to different subjects or branches of a subject included in the curriculum of a public examination, the authorities are generally guided by the needs of training in the subject in future vocations of the students. In case of weighting of different branches of Mathematics in School Final Standard, for instance, they might have taken into consideration the needs of those who would take to collegiate education in arts and sciences, as well as the needs of those who might not proceed further with college Mathematics courses. But there should be one more point for consideration in this regard, that is : whether the responses to question paper set under such allotments are leading to realisation of the objective of ranking of candidates. The present study is an investigation into, (i) whether weights decided upon by the Examining authority are really at work, and (ii) whether the weighting system leads to a maximum discrimination among the candidates. Methods of obtaining optimum weights have been illustrated by some data on the scores on three branches of Compulsory Mathematics, namely Arithmetic, Algebra and Geometry, secured from the record of one year's School Final Examination, West Bengal.

24. Predicting success in Multi-purpose Schools.

F. S. CHOTHIA, Bombay.

With a view to preparing instruments for the dual purpose of guiding pupils to select different courses at the end of the seventh standard and selecting pupils for these courses on the basis of their aptitudes the Vocational Guidance Bureau of the Govt. of Bombay conducted an experimental study in two technical high schools and one multipurpose school. To the new entrants of the first year of these

schools a battery of Psychological tests was administered and the test scores were then correlated with the examination marks at the end of the year. The results suggest that the following aptitudes are important for guidance and selection for the three streams : for the academic stream—verbal intelligence ; for the technical stream—non-verbal intelligence, spatial ability and numerical ability ; for the commercial stream—verbal intelligence and numerical ability.

25. An Achievement Test in Geometrical Reasoning (Hindi).

DEV RAJ VIJ, Aligarh.

The test aims at testing the Reasoning Ability of the IX, X and XI class students in Geometry. There are 89 items in all which have been so constructed as not to omit any important portion out of the geometry syllabus prescribed for the Matriculation classes and also that such portion gets its due weightage.

Only two types of objective forms i.e. Free Response and Multiple Choice, have been used. Directions are given on the cover page of the test copy. 'TRY OUT' of the test has been made on a random samples of 312 IX class students (both sexes) drawn from all the high schools of Aligarh. Discriminative Index of each item has been obtained and only those items have been taken to be valid which have their Discriminative Index ranging between 0.15 and 0.7. Out of the 89 items, 17 have been rejected which are shown as crossed in the test copy of the rest have been re-arranged in increasing order of difficulty according to their Facility Value. Reliability has been calculated by the Split Half method and corrected by the Spearman Brown or Prophecy formula. It comes out to be .96.

The present paper includes only this much work. The author has the following scheme for future work in this very connection :—

1. Validation of items against samples of class X and XI.
2. Calculation of the Grade Norms for three classes separately.
3. Establishing validity of the test against traditional examinations in Geometry.

26. Stimulus words as complex Indicators in Diagnostic free association.

DR. BIMALESWAR DE, Muzaffarpur.

Jung has advanced a theory on the Association method (1910) regarding the value of emotionally toned stimulus words in producing associative disturbances and as is well-known, he has incorporated this theory as the basis of his widely used Word Association Test.

Recently this theory has been corroborated by Rapaport and his associates on quantitative grounds, in a study on WAT which is different from Jung's in essential respects (1945).

The present paper has attempted to examine the diagnostic validity of Jung's theory by employing the same scoring and quantitative techniques as used in the Rapaport study, but the WAT is used for this study is, unlike Rapaport's, essentially Jungian in nature.

TEST

On the basis of previous works a new individually administered WAT is constructed on the pattern originally suggested by Jung, special attention being devoted to the selection of stimulus words and to the system of scoring adopted which included among other such diagnostic categories as were reported significant by previous investigators.

The present study is based on the response patterns of 50 normal adult males, the mean age of the group being 21·9 years.

RESULTS

Statistical treatment of the data gave the following results :—

			Emotional St. Words.	Neutral St. Words.
Mean	...	...	134·24	125·76
S.D.	...	...	17·08	13·9
t=	P=·01			
Chi. Square test.	X ² :		df=49; P=·6.	

Therefore, Null Hypothesis is not rejected.

27. The Concept of Anxiety.

DURGANAND SINHA, Patna.

The phenomenon of anxiety has been engaging the attention of modern psychologists for some time. Its importance has been realised in the field of abnormal behaviour and social behaviour. It has been used to explain many of the phenomena that we meet in the fields of Perception and Remembering.

But anxiety is a very poorly defined and loosely used concept. It is a word of common usage endowed with rich variety of meanings. The writer feels that it is now high time that we had a rigorous definition of the concept without which it cannot have much value as an explanatory principle.

Various usages of the concept prevalent in psychological literature have been examined, and it is found that it has, generally speaking, three varieties of meanings attached to it depending upon its manifestation: (1) Physiological and bodily (2) Psychological and (3) Social and Inter-personal. The author suggests his own characterization of the concept.

28. Neurosis and Delinquency.

DR. N. N. CHATTERJI, Calcutta.

Neurosis and delinquency are very often noticed in a same person. In some cases delinquent behaviour appears first and neurotic symptoms appear later on during the treatment. In other cases on the contrary neurosis is manifested first and delinquent behaviour appears later on. In this paper I want to discuss the psychoanalytical materials obtained from two obsessional neurotic cases who developed delinquency during the treatment and to find out the unconscious motives behind it. In the first case obsessional ideas were prominent where as in the second one the compulsive symptoms. During analysis it was detected that in both the cases there was fixation in the anal sadistic phase of the libido development and both of them expressed a sense of oral frustration also. Because of this fixation they could not adjust their oedipus complex and they showed a flight to homosexuality. Their feminine desire became associated with anal sadistic desires and they showed a tendency to take excreta from men through homosexual acts. The unconscious desire of taking excreta such as faeces is manifested in the consciousness in the form of a desire to take money from men. In their unconscious a phantasy was detected that their mother did not give them milk but it was given to the brother or father and they had kept it in their body as faeces and they wanted to

get it from them by cheating. By showing a feminine type of love they wanted to take away all the valuable excreta from them. This is cheating. This tendency was inhibited due to sense of guilt and when it was removed due to analysis this phantasy became translated in the conscious life in the form of stealing or cheating people of their money.

29. A Critical Exposition of the Dream-theory of Sigmund Freud.

MISS KRISHNA SEN, Delhi.

While there is no doubt that Freud is the most important dream researcher of all ages and that his outlook is scientific and practical, it cannot be said that his theory of dreams is free from any defect. The paper gives the findings of the present writer after a close study of the Freudian literature on dream-analysis.

30. A Psychological Study of Accidents in a Factory.

SRI RAMANATH KUNDU, Calcutta.

(Communicated through Mr. S. K. Bose, Calcutta University)

The study under report sponsored by the Indian Council of Medical Research forms the closing part of the main enquiry of devising a suitable battery of tests for selecting industrial workers who are not accident-prone. The study was carried out in the factory of Dunlop Rubber Co. (India) Ltd.

Ninety-six workers were examined. They were divided into three groups and were designed respectively as Group-I (O-accident), Group-II (1-accident), Group-III (multiple accidents). The correlation was worked out between the accident rates of the workers and their level of performance in the different psychological tests composing the battery. The tested individuals were graded on the basis of their respective test scores in the five tests.

31. Study of Reaction-time and Concrete Intelligence upon Accident Causation of some Industrial Workers.

DEBABRATA BANERJEE, Calcutta.

72 industrial workers who had sustained accidents, ranging from 1 to 9 in number during their period of service in a Calcutta factory were put to psychological testing. Their reaction-time and Concrete intelligence were measured by Vernier Chronoscope and Dearborn formboard respectively. The series of two test scores were statistically correlated with the accident-rates. The correlation coefficients, firstly between intelligence and accident-rate, and secondly, between reaction-time and accident-rate were found to be -0.11 and -0.54 respectively.

The investigator concludes "It repeats the old story as told by the other eminent investigations like Farmer, Chambers etc. that accidents are by no means confined to fools only. A genius or a giant may as much be a victim to accident as a dolt or a dwarf is.

In view of the second correlation co-efficient the present investigator goes as far as to infer, but not with much confidence, "the greater the reaction-time of an individual the less his or her accident susceptibility, or, in other words, the more slow an individual the less he or she tends to sustain accidents—which sounds quite contrary to the popular notions."

32. Abilities and Temperament in the Job of Foremanship.

S. N. ROY and S. C. DEY, Calcutta.

The aim of the present investigation was to determine some of the basic Psychological qualities that contribute towards success in the vocation of "Foremanship." The cases studied were all of successful people in the profession and belonged to various firms and factories viz., Jute, Cotton, Electrical, Chemical, light and heavy engineering etc. Standardised questionnaires devised specially for purposes of job analysis have been utilised in this investigation. The results are expected to be considerably useful for purposes of vocational selection and guidance.

33. Projective Tests and Human Problems of Industry.

K. G. K. PANIKKAR, Trivandrum.

The organisation of industry as a group adventure definitely calls for a psychological study especially of the human problems, based on scientific principles, taking into due consideration factors like the needs, motives, feelings of pleasure and pain, self-satisfaction and frustration, goals and purposes of the worker. Projective tests like the Word Association test, Rorschach tests, Thematic Apperception test may be used with great advantage in analysing the personality of the worker. Since these conventional methods are designed to suit a particular cultural pattern, they require revision and modification to suit the conditions of our country and thus to solve complex problems effectively by going into the very root of these problems.

34. Measure of similarity in work curves.

R. RATH, Cuttack.

An attempt has been made in this investigation to verify the hypothesis that the work curves are based on elementary waves drawn from a "pool of general purposes waves", emergence of any particular wave being determined by factors other than those of the task and subject. A particular subject in a particular task takes a handful of waves but ultimately when he produces a large number of curves he takes all the waves from the pool. If this is correct, his individual curves should widely vary whereas his strong curves having a large number of single curves should be similar in phase and trough and crest placings. This study takes into account 160 work curves from one individual and the grand total of these curves has been compared with another set of 160 curves derived in similar manner from another individual. It was proved statistically that weak curves containing 5 single curves each varied widely whereas strong and very strong curves containing 40 and 80 curves respectively did not vary so much. This variation is still less in the case of two grand total curves which contain 160 single curves each from two individuals. This investigation on the whole proved the 'pool' theory of work curves of Dr. Philpott. The larger the number of curves pooled together the greater is the measure of similarity.

35. Productivity and Industrial Engineering.

J. D. PARIKH, Baroda.

Scientific definition of the term 'Productivity' is given. The role of an Industrial Engineer is to work at the bridgehead where technological problems merge

into social questions. The fulfilment of this role leads to optimum productivity resulting in ever increasing scope of prosperity for the Society. This contribution is made by effecting 'Methods Improvement' programmes in daily jobs.

The paper presents (1) Tools and Techniques, namely; Process Chart, Man-Machine Chart, Flow-Diagram, and Left Hand—Right Hand Chart including Principles of Motion Economy and (2) Systematic Approach for developing an 'Improved Method'—used for effecting Methods Improvements Programmes.

Various Case-Studies are given in the form of 'Suspension Charts' to illustrate the gains in productivity that accrue by Methods Improvement Programmes.

If this Productivity consciousness is developed in an Organisation—be it of any kind—there will be unending scope for progress and prosperity of all concerned leading to a constant upward tone in the economic health of the Nation.

36. Personal Factors in Absenteeism.

DURGANAND SINHA and UDAI PRATAP SINGH, Patna.

An investigation was made to find out how far absence in industry was associated with neuroticism and other personal factors. A Neurotic Inventory consisting of 32 items in Hindi was prepared. Relationship of item-responses to the total test score was determined by using point-biserial method and thereby four items were rejected. The reliability of the inventory, using a parallel form, was found to be .80.

One hundred and fifty workers were studied. They belonged to a lantern factory situated in a small town in Western Bihar employing about three hundred workers. They were classified into three groups on the basis of their absence record, viz., high, average, and low absence groups. High absence group scored significantly higher on the inventory indicating high neurotic tendencies.

Absence was also associated with age, salary, education, tenure of service, skill, marital status, nature of work and residence of workers. Those higher in age and salary, superior in education, longer in tenure had lower absent record. Skilled workers absented themselves more frequently than the unskilled, though no regular pattern was found. Married workers, and temporary workers tended to be absent more often than unmarried and permanent workers. Lastly, workers residing in villages away from the factory had a higher record of absence than those residing in the town itself.

The investigation stresses the importance of various personal factors in industrial absenteeism and, on the whole, agrees with the findings of Russell Fraser, Culpin & May Smith, Bashford, Wyatt & others.

37. Concerning the Validity of an Attitude Scale.

H. C. GANGULI, Kharagpur.

Validity of attitude scales are usually tested by correlating them with such measures as labour turnover, absenteeism etc. Regarding absenteeism, it has been asserted by some (e.g. Kerr) that this is not a uni-dimensional concept. Therefore if satisfaction scores are correlated with total absenteeism, 'unexpected results may be reached. Further, it is said, specific aspects of absenteeism, like unexcused absenteeism may give better results.

A short scale of 12 items for measuring worker satisfaction was constructed according to the principles of summated ratings and standardised by the internal consistency method. It was applied to 380 workers. The morale scores were correlated with different aspects of absenteeism like short medical leave, absent

without pay etc. The only significant correlation with morale scores was given by total absenteeism, the value being -0.43 . It is therefore concluded that for determining validity of morale scores, total absenteeism is perhaps the best criterion. However, as has been pointed out by Vernon, Murphy, etc., if the principle of internal consistency is adhered to, there is no absolute need to validate the scale by means of some external criterion.

38. A Discussion of some Variables Affecting Attitude of Industrial Workers.

H. C. GANGULI, Kharagpur.

The influence of such variables like age of the employee, his length of service, income, income aspiration etc. on his attitude to the total employment situation have been determined. Subjects were 380 workers in a Calcutta mechanical engineering factory. The significance of these influences has been statistically tested.

Results show that province of birth of the employee, amount of his schooling, his annual pay increase and skill at work as rated by his superior do not bear any significant relation to his job satisfaction.

On the other hand, morale shows cyclical changes with increasing age as well as length of service. Of the four considerations affecting satisfaction with income, viz., actual earning, method of payment, income expectation and wage differentials it was found that (i) earnings based on production have a more direct and positive influence on morale than total earning or earnings based on time and (ii) financial expectation has a strong adverse influence on morale. Only when income ceases to be an important cause of dissatisfaction, the craftsmen like carpenters, vicemen fitters etc. are more satisfied than machinists. Also membership of the union which was particularly anti-company in its outlook was associated in a circular causal fashion with poor worker morale.

It is concluded that further research should be directed toward an understanding of the workers' attitudes and changes in these in terms of the basic psychological needs of the individual, how these are affected by factors like age, nature of work etc. and in their own turn affect the satisfaction of the workers.

39. Isolation of some Morale Dimensions by Factor Analysis.

H. C. GANGULI, Kharagpur.

Morale is a multi-dimensional concept. In India however it is mostly treated as a unitary concept and equivalent to the overall satisfaction of the employee with the job situation.

A scale was constructed for measuring morale of industrial workers. It covered four areas of satisfaction—satisfaction with the nature of work, with wages etc., with supervision and with company policies and practices. The survey covered 550 workers in an electrical engineering factory. With 23 of the most discriminating items in the scale a factor analysis was done by Thurstone's Centroid method to test whether morale is multi-dimensional or not.

The analysis brought out three primary morale factors. Factor C refers to the worker's satisfaction with the total organisation and the benefits he derives from it in the form of wages etc. Factor Sp has reference to such items as the supervisor's skill in handling his men, his helpfulness towards them etc., in short, it refers to the satisfaction derived from interpersonal relations with the supervisor. The third factor, factor So refers to the satisfaction with the supervisor's technical competence and efficiency in running the shop. Here such items as distribution of work-load, production planning, workers suggestions regarding improvement of tools and methods etc. are involved.

40. Attitudes of Union and Non-union Employees in a Calcutta Electrical Engineering Factory.

H. C. GANGULI, Kharagpur.

An attitude survey was made in a Calcutta engineering factory. It covered 550 workers. Of these 55% were members of a very anti-company leftist trade union, 8% were members of an 'inside' company supported union and the rest were unattached. For each worker scores on 3 factors were obtained—Factor C which refers to the worker's satisfaction with wages etc. and with the total organization, factor So referring to satisfaction with technical aspects of supervision and factor Sp referring to human relations aspects of supervision.

A comparison of the different union groups give the following results.

TABLE 1

PERCENTAGE OF OUTSIDE, INSIDE AND UOR-UNION EMPLOYEES in DIFFERENT SATISFACTION GROUPS

		Most Dissatisfied	Dissatisfied	Neutral	Satisfied	Most Satisfied
<i>Technical Aspects of Supervision</i>						
Outside Union	...	6.0	35.6	45.7	12.1	0.6
Non-Union	...	0.5	10.3	48.0	35.3	5.9
Inside Union	...	0.0	8.7	30.4	50.0	10.9
<i>Human relations aspect of supervision</i>						
Outside Union	...	5.0	33.9	48.3	10.8	2.0
Non-Union	...	2.0	13.2	43.1	37.7	4.0
Inside Union	...	0.0	6.5	34.8	47.8	10.9
<i>Satisfaction from wages etc. and with the total organisation</i>						
Outside Union	...	4.7	32.6	49.0	13.4	0.3
Non-Union	...	2.0	15.2	43.1	34.8	4.9
Inside Union	...	2.2	6.5	30.4	43.5	17.4

TABLE 2

BISERIAL CORRELATION BETWEEN EMPLOYEE SATISFACTION AND 'OUTSIDE UNION—NON-UNION' MEMBERSHIP

With confidence in company etc. (factor C)	...	-0.410 ± 0.049
With technical aspects of supervision (factor So)	...	-0.500 ± 0.045
With personal aspects of supervision (factor Sp)	...	-0.396 ± 0.049

It thus seems that a circular causal relation exists between poor morale and membership of the independent trade union. It is concluded that this is likely to be the case in factories where there are independent trade unions in conflict with management.

41. The Structure and Functions of Mind.

P. N. MATHUR, Delhi.

Study of the nature of stimuli, the psychic processes of cognition, conative memory, and the morphological evolution running parallel to mental evolution is

gest that "mind" consists of partly undifferentiated and partly differentiated energy.

The well defined quanta of energy manifest as waves having definite amplitudes, wavelengths, velocities and intrinsic energies. They exist in four states : (1) the unconscious containing congenital-potentials and highly damped experiences; (2) the sub-conscious consisting of damped and repressed potentials due to experiences and intra-psycho activity; (3) the pre-conscious consisting of recent experiences damped from the conscious and remote experiences which have been re-informed from time to time, (4) the conscious consisting of the waves within a certain range of amplitude, called the cognito-amplitude, produced by the environmental stimuli or intra-psycho activity.

The functions of the mind are regulated by definite laws studied under four heads : (1) The laws of Psycho-impressions; (2) the laws of Psycho-Distribution; (3) the laws of Psycho Assimilation and (4) the laws of Psycho-Manifestation.

Mind builds up the cells and tissues of the body from the environmental law-materials, co-ordinates the voluntary as well as the involuntary activities, manufactures psycho-genic diseases and cures pathological symptoms.

42. Mental Orientation.

PREM NARAIN MATHUR, Delhi.

Mental orientation is the process of intra-psycho activity, by which the potentials determining the behaviour of an individual are formed.

The process commences in the intra-natal life during which the racial propensities are formed according to the laws of Phylogeny and Ontogeny accomplishing the uniformities of the species and the diversity of the individuals.

As the infant grows the personal experiences begin to differentiate psycho units, patterns and spheres of influences, according to the laws of contiguity, associations, inhibitions, re-inforcements etc.

The attachment of an experience, thought or phantasy with a particular pattern determines the details of the manifestation of the corresponding activity.

Study of the life-history, thoughts, phantasies and dreams of a person reveals the mode of orientation of the various aspects of the personality and their relationship with the behaviour and individual aberrations.

By a process of analysis followed by re-orientation the desired cure can be accomplished. So long as one does not understand the configuration of one's own personality, one remains merely a constitutional monarch of the personality, but by understanding its components and orientation one can exercise better control over one's own activities.

43. Human Activity.

PREM NARAIN MATHUR, Delhi.

The various congenital and acquired psycho units are capable of being energised. When the kinetic energy of a unit acquires the momentum sufficient to overcome the inertia of the motor mechanism, bodily activities are produced. They are governed by :

1. The law of anti-inertia, which states that the propensities can initiate motor-activity of the body even without being acted upon by the outside forces.

2. The law of goal-formation, which states that psycho unite when supercharged with energy form patterns for realisation.

3. The law of sustained activity, which states that the propensities continue to provide energy for the activity necessary to attain the goal, even without the stimulus being continued.

4. The law of achievement, which states that as long as the potential forming the goal is not completely exhausted the propensities continue to develop their kinetic energy.

The activities are classified as :

1. Diffused movements which are not co-ordinated.
2. Reflex actions, which are energized by the propensity of Self-preservation.
3. Autonomic movements due to inter-psyhic activity.
4. Instinctive movements due to the stimulation of the congenital potentials.
5. Deliberate movements controlled by the conscious thoughts.

Glandular secretions and the chemical composition of the organism also influence the activities.

SECTION OF ENGINEERING AND METALLURGY

President :—DR. B. N. DEY, D.Sc. Engg. (Glas.), M.I.E. (Ind.).

Abstracts

FOUNDATION ENGINEERING

1. Bearing Capacity of Foundations by Actual Load Tests.

K. P. SHUKLA and R. P. SRIVASTAVA, Roorkee.

No reliable method exists by which bearing capacity of foundations can be assessed. A number of empirical formulae exists by which estimate of actual load that a foundation could take exists, but it always appears safer to perform the actual loading test. For this purpose a loading device has been designed, and the area actually loaded is 1 square foot. The maximum permissible settlement for buildings is 0.25 inch and the load on which this settlement could be achieved has been taken as the safe bearing load.

2. Unconfined compression test of soil with different size-ratio of the test specimen.

S. P. BAIDYA, Maithon.

Unconfined compression tests were performed with cylindrical specimen for large number of soils having proctor compaction. The specimens had a fixed diameter of 1.45 inch and different heights. Compressive strengths were plotted against the corresponding size-ratio (height to diameter) for each soil.

It is observed from the nature of the curve that compressive strength corresponding to the size-ratio around 2, is higher than the same on both sides of it. Compressive strength increases steadily with the decrease of the size-ratio generally below 1.5.

The nature of the curve is explained as follows. For size-ratio smaller than 2 compressive strength of the test specimen increases due to the reaction produced by the proximity of its two dead zones. Below 2 the vertical strain and above 2 the horizontal strain reach yield point each earlier than the other. Around 2 these two strains reach yield point simultaneously and the specimen satisfy Mohr's criteria of shear failure according to which yield should occur when the difference between the two principal stresses is maximum.

3. Changes in some of the physical properties of black cotton soil effected by ionic substitution.

B. B. ROY, Poona.

Studies were made on the changes in some of the physical properties of black cotton soil effected by progressive base saturation with sodium and calcium. With sodium saturation, both the liquid limit and the plastic limit of the soil increased, but on saturation with calcium, while the liquid limit was not very much affected, the plastic limit at first increased and then remained constant. Consequently, while sodium saturation increased the plasticity index of the soil, calcium reduced it. The hygroscopic moisture at all different humidities decreased in both cases.

However, at low vapour pressure sodium saturated soil absorbed less water than the calcium saturated sample, but reverse was the case at higher vapour pressure. The heat of wetting of the soil decreased with increasing saturation with sodium but increased when saturated with calcium.

4. Movement of Moisture in Heavy Clays.

K. P. SHUKLA and D. N. BHARGAVA, Roorkee.

With a view to evolve an analytical method for the determination of moisture profiles at any time in field of heavy clay, laboratory and field experiments were carried out. In the laboratory, soils of different mineralogical composition were examined under different boundary conditions and initial moisture distribution. Moisture profiles at different time were determined experimentally. These were also calculated mathematically. For latter purpose, the movement of moisture was supposed to take place predominantly as diffusion; hence according to equation :

$$\frac{\delta c}{\delta t} = \frac{k}{\sigma} \frac{\delta^2 c}{\delta x^2}$$

where c is the moisture constant expressed as fraction of dry matter, k the diffusion constant and σ the unit weight of soil with the known boundary condition, initial moisture distribution as $C_0 = \text{constant}$ and k and σ determined experimentally the solution was given by

$$C_t = C_m + \sum_n \left(\frac{1}{2e} e^{-\frac{k}{\sigma} \left(\frac{n\pi}{2e} \right)^2 t} \int_0^e (C_0 - C_m) \sin \frac{\pi n x}{2e} \sin \frac{\pi n x}{2e} \right)$$

C_t = moisture distribution at any time t and C_m that at $x=0$. Under the conditions imposed on the experiments and with the clay content in soils that were examined varying from 50 to 60% the analytical results agreed with experimental ones fairly closely.

The field experiments were carried out in a sugar-cane field where water table was at a depth of 15 ft. Moisture profiles were determined systematically for number of days after giving an inch of initial irrigation. Some of profiles were also calculated according to above hypothesis after determining diffusion constant in the following manner.

A relation between moisture content x at 30" depth and number of days y was found out to be a sine curve given by

$$y = 28.5 + 0.7217 \sin \frac{2\pi x}{3} - 1.25 \cos \frac{2\pi x}{8}$$

The first differential of y with respect x for all values of x gave the diffusion constant.

Some of the moisture profiles that were determined analytically agreed fairly with the experimental ones.

5. Electro-Chemical Treatment of Clays, Part IV.

K. P. SHUKLA and ANIL KUMAR, Roorkee.

Experiments reported in the previous Communication (Proceedings Indian Science Congress 1955 Page 96) were continued. Further work was concerned with elucidating and identifying the formation of secondary unstable compounds during

the process of electrification of soils. The soil reactions, dehydration and acidimetric studies were continued as before. The ultimate aim of the study being adopting the method of electro-chemical treatment to foundation problems, the consolidation characteristics of clay samples obtained after every stage of electric treatment were studied alongwith.

The two soils each representing the montmoriollinite and kaoline group of clay minerals were selected for study. As before, experiments were carried out with cent per cent hydrogen clays which were previously freed from organic matter and free salts. Each of these soils were subjected to 8 cycles of electric treatment and the analysis and tests mentioned above were carried out after each stage.

The results confirm that monmoriollinite clay suffers pronounced decrease in Base exchange capacity, $\text{SiO}_2/\text{Al}_2\text{O}_3$ and $\text{SiO}_2/\text{R}_2\text{O}_3$ ratios than Kaolinite clay. The treated sample has almost a constant pH while the leached sample show a progressive increase in pH.

There is a pronounced improvement in consolidation properties of the clays on treatment with electric current. The coefficient of compressibility decreases from 0.27 to 0.13 ft.²/ton at the end of 6th cycle while coefficient of consolidation increase from 2.10×10^{-3} in.²/min. to 24×10^{-3} in.²/min.

FUEL TECHNOLOGY

6. Utilisation of Indian low-grade coal in Shell-type Boilers.

S. N. PUSHILAL, Kharagpur.

This paper deals with the problem of utilising the low grade Indian coals in shell-type boiler. In India the reserves of high grade coal are limited, and unless an efficient way of burning the low grade coal is found out, it is difficult to solve the fuel-problem. In the Shell-boilers, huge quantities of Indian coals are burnt annually, and much of this coal is wasted due to lack of care and knowledge for their efficient combustion. Much may be done to reduce this loss by maintaining proper conditions for combustion, proper fuel-size, air supply, moisture content etc.

Research work done on similar lines in the British coal utilisation and Research Association (B.C.U.R.A.) and the fuel research station (F.R.S.) has been described. The scope of Research work in India and the lines on which it can be carried out has also been suggested in this paper.

7. Specific Surface of Coal Powder.

B. C. DATTA and S. K. NANDI, Kharagpur.

Specific surface of bituminous coal powder of different sizes—10, 30, 60, 100, 150, 200 and 300 mesh B.S.I. was determined by permeability method. Such data are essential for calculating the efficiency of a coal pulverizer. About 4-9 gms coal sample were kept in a permeability tube, alcohol percolated through the bed either at atmospheric pressure or at a low vacuum of 4-8 cm. Hg and the rate of flow measured by collecting the liquid for 5-20 min. From the resistance offered to fluid flow by the particle bed, specific surface, S_o , was calculated from Carman equation

$$S_o = 14 \sqrt{\frac{1}{K} \frac{B^3}{(1-B)^2}}, \text{ where } K = \text{Permeability and } B = \text{Porosity.}$$

Analytical data of the coal sample are :—Moisture—0.76, ash—24.85, volatile matter—24.54, fixed carbon—50.15%, sp. gr.—1.46 and Hardgrove grindability index—73.37.

For the following average particle sizes 1166, 375, 200, 128, 90 and 65 microns, the specific surface was found to be 100, 390, 786, 1840, 3700 and 8150 sq. cm. per gm. respectively. At least 4 runs were taken for each sample and the mean value taken as the final result. The results when plotted follow a smooth curve.

8. Effects of Operating Variables on Ball Mill Crushing.

B. C. DATTA and S. K. NANDI, Kharagpur.

The effects of different operating variables on the efficiency of crushing of coal were studied in a steel ball mill, 8" dia. \times 8 $\frac{1}{4}$ " length, filled with 100 steel balls 1" dia. and operated at 44 r.p.m. Cumulative per cent undersize, obtained by sieve analysis of the product ranging from 10 to 300 mesh, was plotted against reciprocal of size. Area of the curve, which was proportional to new surface created, was a measure of the efficiency of crushing.

Effect of time of crushing :—With 500 gms coal feed, $\frac{1}{8}$ - $\frac{3}{16}$ " size, areas obtained after crushing for 5, 10, 15, 30, 60, 180 and 360 minutes were 27.6, 36.5, 40.5, 43.8, 46.9, 48.5 and 49.6 cm² respectively, which shows that crushing efficiency decreases with time.

Effect of feed quantity :—With 100, 250, 500, 1000 and 2000 gms of coal feed, having the M/V ratio or ratio of vol. of material to void vol. of balls as 0.18, 0.45, 0.9, 1.8 and 3.6; 1, area for the total quantity of feed were 61.7, 124, 220, 327 and 264 cm² respectively, which shows that M/v ratio of 1.8:1 gives the maximum efficiency.

9. Briquetting of Weathered Coal fines: Part I. Influence of quality and quantity of tar on the briquette strengths.

D. P. AGRAWAL, M. G. KRISHNA and S. HUSAIN ZAHEER, Hyderabad-Dn.

With a view to utilise the high ash noncaking weathered coal fines an attempt has been made to briquette them using a low temperature tar obtained from the Lurgi Spuelgas Plant installed at the Central Laboratories, Hyderabad Dn., as a binder after suitable modification with lime. There are many variables that influence the strengths of the briquettes prepared with lime-tar as binder. In the present investigation the influence of the quality and quantity of tar on the strength of the briquettes have been reported. It is found that lime treated tar gives stronger briquettes than either pure tar or pitch obtained from the same tar. The result also indicate the likelihood of the high boiling tar-acids being primarily responsible for the lime tar reaction. 15% of tar is the optimum proportion and briquette obtained using coal 100 parts, tar 15 parts and lime 1.5 parts—all on dry basis—have a crushing strength as high as 700 lbs. per sq. inch.

10. Briquetting of Weathered Coal Fines: Part III.

D. P. AGRAWAL, M. G. KRISHNA and S. HUSAIN ZAHEER, Hyderabad-Dn.

In this part the influence of type and proportion of lime, proportion of moisture in the final mixture and the mode of application of binder on the strength of the briquettes prepared with weathered coal fines and the low temperature tar (LST-h) have been reported. The results indicate that briquettes with slaked lime

possess better mechanical strength and about 20% moisture in coal, lime and tar mixture is optimum. It is also found that better briquettes are produced when the binder is first made outside with requisite quantity of lime, tar and water, then applied to coal, mixed at 70°C for half an hour and briquetted at 4000 lbs/sq. inch.

11. Studies on Kashmir Lignite.

B. K. SAHA, A. K. KARMAKAR and S. K. NANDI, Kharagpur.

Four samples of Kashmir Lignite from different beds were obtained. Proximate analysis of the air dried lignites gave moisture—7.8 to 13.3%, Volatile matter—27.6 to 34.3%, Fixed Carbon—7.6 to 16.5% and ash—36.5 to 52.6%. Ultimate analysis on moisture and ash free basis gave carbon—58.4 to 65.8% and Hydrogen—2.6 to 5.4%.

Carbonization of 100 gms lignite in a Fischer Aluminium retort at 520°C gave yields of char—62.5 to 71.5 gms., tar—3.9 to 6.9 gms. and gas—6.6 to 8.5 litres. The char contained volatile matter—12.3 to 12.4, Fixed carbon—9.2 to 27.2 and ash—60.5 to 78.4%. Gas burned with a low flame and analysis showed CO₂—39.8 to 48.4, CnHm—1.2 to 1.4, O₂—3.0 to 3.9, CO—7.9 to 10.0, H₂—13.7 to 14.3, CH₄—8.2 to 10.2, and N₂—17.4 to 20.6%. Different fractions obtained by tar distillation were upto 200°C—15.1, 200 to 300°C—43.7, 300 to 360°C—25.3 and residue—15.9%.

Different methods were tried to deash the lignite e.g.—autoclaving with water at 300°C and 150 atmospheres, froth flotation, acid treatment and reduction to different sizes, but none proved very successful, maximum deashing obtained was about 9%.

12. Carbonization of South Arcot Lignite.

B. K. SAHA and A. K. KARMAKAR, Kharagpur.

Experiments were conducted on 2 samples of lignite obtained from South Arcot, Madras and average results of the 2 air dried samples are given below. Proximate analysis :—Moisture—14.1, Volatile matter—46.6, Fixed Carbon—35.6 and Ash—4.3%. Ultimate analysis on moisture and ash free basis :—C—68.5, H₂—4.3, S—1.3, N₂—0.8 and O₂—25.2%. Gross calorific value—10,675 B.t.u./lb.

Low temperature carbonization was done at 520°C in a Fischer retort both with lignite as such and after briquetting. Very hard briquettes could be made by application of hydraulic pressure only (about 400 atms.) without using any binder. The percentage yields were char—52.7, total aqueous part—28.2, tar—7.4 and gas—11.8 litres at s.c. Proximate analysis of char :—Volatile matter—19.8, Fixed Carbon—70.2 and Ash—10.0%; Ultimate analysis on ash free basis :—C—83.8, H₂—6.1, S—1.5, N₂+O₂—8.6, Gross C. V.—12,850 B.t.u./lb. Gas was combustible and its composition was CO₂—43.6, CuHm—2.1, O₂—3.2, CO—15.5, H₂—8.6, CH₄—10.3, C₂H₆—1.7 and N₂—16.0.

13. Studies on South Arcot Lignite, Part II.

M. R. BASU and H. N. DAS GUPTA, Dhanbad.

Dissolved salts from ordinary water are nowadays removed completely with the help of synthetic ion-exchange materials. These are mostly of organic origin, consisting of either sulphonated natural organic material like coal, coke, charcoal, lignite and wood shavings or synthetic organic resins containing active sulphonic

groups and derived frequently from phenol-formaldehyde, or polystyrene resins. The present communication embraces the results of an investigation made with a view to studying the base exchange capacity of South Arcot Lignite without taking recourse to suphonation process. Experimental results, so far obtained, go to show that the base exchange capacity of the raw lignite sample is of the order of 13 milliequivalents per 100 gm. If, however, the lignite powder is simply treated with dilute hydrochloric acid and then washed with water, this value increases to 20 m.e. per 100 gm., which is also the value for Ball clays. Comminution does not help increase in the base exchange capacity of the lignite. Electrodialysis may help increased exchange capacity and work in this direction is in progress.

FLUID MECHANICS

14. Design and Performance of Ejector.

D. K. GUHA and A. N. ROY, Kharagpur.

The study of the jet action, in general, has assumed great technical importance in recent years. The principle of jet flow is largely exploited in ejectors in which the kinetic energy of one fluid is used to drive a second fluid.

The present investigation was undertaken with a view to designing an efficient ejector in which the driving fluid is a compressed gas and the entrained fluid is a liquid or a slurry.

Using the equation developed by R. A. Smith (Some Aspects of Fluid Flow, p. 229-41, Edward Arnold & Co., England, 1951) as the basis, several ejectors have been designed and their performance tested for 'Air-Air' system. Experiments were carried out with nozzles of different diameters and compressed air (25 to 100 lbs. square inch.) as driving fluid, entrained fluid being atmospheric air. From a study of the following design factors:

1. Nozzle efficiency in terms of suction pressure,
2. Effect of dimensions, e.g.—length of the mixing zone, distance of the nozzle end and from the entrance to the diffuser throat, forms of diffuser, etc., the optimum nozzle diameter and the optimum distance of the nozzle end from the entrance of the diffuser throat which result in maximum suction to entrainment, have been determined. The data obtained will find application in the design of an efficient ejector to be incorporated in a Fischer-Tropsch Slurry reactor.

ELECTRICAL ENGINEERING

15. Planning for the Future Rural Distribution.

DR. M. DUTT and SRI R. N. GANGULY.

Great emphasis has been placed both by the Central and State Governments for the industrial development of our country during the Second Five Year Plan period. To achieve rural economy, development of cottage and medium size industries over a large scattered area is called for. Power is an essential prerequisite for initiating such schemes. The question of reducing capital costs for distribution is one of the most pressing needs and to accomplish this, engineers must have to devise means by which it may be cut down to minimum. In this article details have been laid down how by proper planning and standardisation of the following items, cost of rural distribution can be reduced to bare minimum.

- (a) *Conductor*—Use of A.C.S.R. is advocated in cases where load requirement entails the use of conductor over .05 sq. in. copper equivalent. All

aluminium conductor should be used for all Lines requiring lower sections. Galvanised steel wire is to be used where there is no possibility of having branch line.

- (b) *Poles*—90 lbs. Rails for 33 K.V. and 60 lbs. rails for light construction upto 11 K.V. and wooden poles for L.T. distribution are recommended.
- (c) *Cross Arm*—Should be made of steel channel of standard design.
- (d) *Clearance & Stringing*—F.S. should not be less than 4 for normal condition and tension during actual worst loading condition should not be more than 60% of the ultimate strength of conductor.
- (e) *Guard Wire*—We do not advocate its use.
- (f) *Anchor Rod & Plates*—Prefab. concrete buried plates for heavy angle construction and screw type anchor for Light construction are suggested.
- (g) *Transformers*—Use of 3 or 5 K.V. A single phase transformer without taps for village distribution is recommended. Use of Boosters and capacitors should be more popularised.
- (h) *Protection*—O.C.B. in conjunction with inverse time characteristic relays and auto recloser should be used for important and heavily loaded H.V. feeders. For ordinary feeders T.A.P. breakers may be used. Small transformers may be provided with fuse on H.V. side but no fuse is necessary for L.V. side.
- (i) *Earth return*—Experimental use of single line steel wire construction on wooden poles with ground as return path is suggested for rural distribution.
- (j) *Construction*—Some standard methods and rules have been suggested with regard to pole position, span, minimum ground clearance, Railway crossings, etc. Material schedule should be properly made out and facilities for transport should be properly arranged to avoid idle time and labour.

16. Behaviour of Saturable Reactors in Magnetic Amplifiers.

P. N. DAS, Howrah.

The exact behaviour of saturable reactors when used in a magnetic amplifier, depends not only on the nature of material of the core and the magnitudes of d.c. and a.c. excitations used, but it also depends, to a great extent, on the external circuit conditions. Even with an idealised core and with the optimum values of d.c. and a.c. excitations for the given magnetic amplifier, its behaviour depends on a number of other factors namely on the number of cores used, on the nature of d.c. source and the way in which a.c. and d.c. windings are connected.

Its exact behaviour in a number of different cases has been studied and explained from fundamental considerations. These cases are:—1. A single core with the d.c. source of (i) infinite and (ii) low impedance. 2. Two cores series connected with the d.c. source of (i) infinite and (ii) low impedance. 3. Two cores parallel connected with the d.c. source of (i) infinite and (ii) low impedance. The B-H loop described becomes unsymmetrical in certain cases but symmetrical in others. Similarly the a.c. current wave becomes flat-topped in certain cases but peaky in others. The flux density and the current through the d.c. winding also vary differently in different cases. All these differences in behaviour in different cases have been explained and some important results have been deduced. The movement of the working point in the B-H curve with the applied a.c. voltage has been determined in different cases and it has been shown that the average value of a.c. current is zero in each case. The relation of the rectified average value a.c. current to d.c. current has also been found out in different cases and

it has been shown that the fundamental formula for amplification in the case of a magnetic amplifier has to be modified in accordance with external circuit conditions.

17. The Phenomenon of Corona and the Concept of Critical Voltage.

M. P. VARSHNEY, Kharagpur.

First of all the conventional notion of corona phenomenon and the concept of "critical voltage" is described. This is followed by a new interpretation of the phenomenon arrived at as a result of experimental corona researches carried out throughout the world particularly at Chevilly and Tidd stations in France and U.S.A. respectively. The corona loss curve is subdivided into 3 zones : point, transitional and envelope corona. Point corona occurs at singular points of small base with high field concentration during the negative half-cycle peak. Transitional corona follows at edges with a large number of bases with high power capacity and ionisation during the positive peak. Envelope corona occurs when the surface field strength has reached such values that losses occur at numerous bases so as to form a glowing envelope in both half-cycles with increasing capacitance. These three kinds of radiations are to be considered as super-imposed upto mutual penetration and not as a changeover. This makes us to do away with the conventional notion of "critical voltage."

It is found that the phenomenon of radio influence due to corona interference field actually begins long before losses are noticed and this gives a death blow to the concept of "critical voltage" from a physical viewpoint.

17A. Modification of a Recently Suggested Special Type of Group Relaxation.

R. N. BASU, Kharagpur.

In this paper a modified method for liquidation of residuals in the solution of a set of simultaneous linear equations has been used. It offers an easy process (for certain types of equations) for obtaining suitable operation blocks which can be utilised in liquidating the residuals without bringing about any change in one or more of the remaining residuals. This is a variation of a method previously suggested by Bandyopadhyay and Narsimhan (Vide Science Congress Abstracts, Baroda Session, 1955, Section of Engineering and Metallurgy, Abstract No. 6).

The example constructed to illustrate the method also gives an easy way for obtaining the voltage distribution in a string insulator (consisting of a large number of units) when the varying capacitances between link-pin and line conductor are taken into consideration.

18. A. Universal A.C. Meter Tester.

P. VENKATA RAO, Bangalore.

The investigation relates to the development, design and construction of a portable electronic A.C. Meter Tester which can be used for testing all types of A.C. meters, relays and instrument transformers. The design of the equipment is based on the principle of 'Phantom Loading' which is well-known to the engineers in the Power field. It consumes about 200 watts and can be operated on 220 V-50 cycles commercial power supply. It has a voltage range up to 600V and a current range up to 50A.

RADIO ENGINEERING AND ELECTRONICS**19. The Study of the Angle of Arrival of the Downcoming Radio Waves from the Ionosphere.**

S. S. BANERJEE and D. K. BANERJEE, Banaras.

Short radio waves propagated via the ionosphere generally arrive at the receiving site at different vertical angles. A knowledge of these angles of arrival is of great theoretical as well as practical importance. The angle of arrival of short wave signals radiated from five stations located at Delhi (30.75 m), Calcutta (41.61 m), Bombay (41.44 m), Colombo (31.51 m) and Karachi (19 m) were, therefore, measured at Banaras by the phase difference method with two horizontal dipole aerials. The aerials were, however, vertically spaced instead of being horizontally spaced as generally used. This system has two distinct advantages, viz., in the first place, the sensitivity of the system does not fall with the decrease of the angle of elevation, so that the aerial spacing need not be increased in order to make the system sensitive to low angles of elevation. Secondly, the accuracy of the system does not alter for different azimuthal angles which makes the present arrangement highly suitable for the measurement of the angles of arrival of downcoming radio waves radiated from stations situated on any side of the receiving system.

The angle of arrival of radio waves from the above five stations, all of which radiated c.w. modulated and unmodulated signals, was determined for afternoon hours. It was found that excepting Delhi, the signals from all the stations arrived at Banaras in more than one vertical angle. The experimental values of the angles were verified by the calculated values obtained after due correction for the curvature of the earth and the particular mode of reflection corresponding to any angle was determined. Though various modes of propagation were simultaneously present it was found in all cases that a particular mode was more prominent than others. It has been generally observed that greater the distance of the station the higher is the order of reflection which is most favourable for reception.

20. Absorption of Ultra Short Radio Waves due to Reinforced Concrete.

S. S. BANERJEE and P. C. BANERJEE, Banaras.

The effect of the reinforced concrete building roofs situated over ultra-short wave transmitting aerials on the fieldstrengths obtained in the vicinity of such aerials has been investigated and the results have been published in one of our previous publications (Jour. Sci. & Industr. Res., 1955, vol. 14B, No. 2, p. 51). An effort was also made to calculate the dielectric constant and conductivity of such materials from the above observations. Recently the work has been further extended to study the absorption and the depth of penetration of such waves travelling through these building materials. For this, the fieldstrengths have been measured immediately below and above the reinforced concrete building roof with horizontal dipole transmitting aerial. It has been observed that the value of the conductivity obtained by the present method is slightly higher than that obtained on the previous occasion, as in the present case, the depth of penetration of the wave travelling through the material has been taken into account.

21. A Variable width D.C. Pulse Generator for Ionospheric Equipment.

S. S. BANERJEE and T. V. S. MURTY, Banaras.

It has been often found necessary to change the width of the radio frequency pulses radiated from a pulse transmitter used for ionospheric measurements. For

this purpose a variable width d.c. pulse generator has been designed and constructed which can be used in conjunction with an electronic switch for triggering the pulse transmitter. The d.c. pulse generator generates sharp peaky pulses in three stages, viz., the generation of square wave from a rectified 50 cycles a.c. input, the differentiation of the square wave into sharp peaky pulses of either polarity and finally the rectification and amplification of the differentiated pulse. The pulse-width is altered by varying the resistance in the series R-C network used for differentiating the square wave from about 100 micro-seconds to 2 milli-seconds. The amplitude of the pulse can also be altered and thus a pulse of proper width and amplitude can be chosen to trigger the switching unit which in turn operates the transmitter. Thus the ionospheric equipment has been found to radiate suitable pulses at a constant repetition frequency of 50 per second with the help of the variable width d.c. pulse generator. It may however be mentioned that the pulse recurrence frequency of the transmitter can also be altered by applying a variable audio frequency signal after proper amplification at the input of the d.c. pulse generator.

22. Abnormal Horizontal Gradient of Ionisation in the F_2 Region of the Ionosphere.

S. S. BANERJEE and P. G. SURANGE, Banaras.

It is well-known that normal east to west horizontal gradient of ionisation exists in the ionosphere due to the variation of zenith distance of the sun at different places. Such a gradient of ionisation can be determined from the observations of scattered radio signals as indicated in one of our previous publications (Jour. Sci. & Industr. Res., 12B, 277, 1953). The purpose of the present communication is to show that besides the normal gradient of ionisation, there often occurs abnormally high gradient of ionisation within a limited region of the F_2 layer of the ionosphere which may considerably affect the mode of propagation of the radio waves through the ionosphere. It has been further shown that such a high gradient of ionisation can be calculated from the observations of back-scattered echoes received from the ground near about a pulse transmitter, assuming the semi-thickness and the lower boundary of the ionospheric layer to remain constant within the short region of the ionosphere.

23. X-ray diffraction studies of alpha-brass on progressive dezincification in vacuum.

DR. G. P. CHATTERJEE, Sibpur.

On the introduction of solute atoms B in a solvent lattice of atoms A, the lattice parameters change depending on the sizes and valencies of the atoms and the nature and symmetry of the A-A, B-B and A-B bonds. In the Face-Centered-Cubic lattice of pure copper, the volume per atom of copper is 11.76 \AA^3 . As copper atoms are gradually replaced by zinc atoms in brass, the lattice expands almost linearly at first at the rate of $.025 \text{ \AA}^3/\text{atom\% Zn}$ upto about 20 atom %Zn and then somewhat more rapidly. If zinc be withdrawn from brass it is found that the lattice contracts but not in a reversible way. There is an appreciable positive deviation at the initial stages of dezincification leading ultimately to a small negative deviation on prolonged dezincification. The implications of positive and negative deviations have been indicated.

24. Single Valve Sawtooth Generator.

V. V. R. INDULKAR, Kharagpur.

A single tube generator for displaying fast pulses and other waveforms is designed. A linear sweep is produced by operating a screen coupled blocking

oscillator on the sinh-sin mode of operation where the pulse length T is equal to $\frac{\pi c \sqrt{L_2}}{\sqrt{(c-g^2 L_2)}}$. The sine wave oscillations, which are present at the grid of the screen coupled blocking oscillator charge the interelectrode capacity of the tube or the lumped capacity as the case may be, giving out linear sawtooth oscillations having a repetition frequency above 60 Kc/s, when the sinusoidal wave form passes through zero i.e. rising from maximum negative value towards maximum positive. As the sine wave reaches the positive peak, the tube conducts and the capacitor is discharged through the tube.

The repetition frequency of oscillations is mainly determined by the primary inductance of the transformer and the stray capacitance present. The repetition rate can be varied by adding a variable capacitor across the primary which varies the resonant frequency there by varying the repetition rate.

For the extension of the available frequency range, the inductance in the circuit is adjusted by means of a rotary switch, which varies the inductance of the screen winding and maintains the turns ratio constant (i.e. 1 : 1).

The sweep generator is useful where the cheapness and fairly good accuracy is required.

25. Two Wire Repeater as a Gyrator.

DR. K. K. BOSE, Kharagpur.

The gyrator as a new circuit element was first introduced by Tellegen in 1948, as a transformer of voltage into current and current into voltage. In practice however this ideal is never fully achieved by passive networks. In 1954 Nonnenmacher and Schreiber of Stuttgart University, Germany, first found that an ordinary two wire Telephone-Repeater, after certain modifications behaves almost like an ideal gyrator. In the present work the author has established the mathematical formulae of such a repeater from the stand-point of 4-terminal network theory. Many uncommon peculiarities of the gyrator have been discussed, e.g., a parallel resonant circuit would behave like series resonance, and vice versa, when connected at the output of the gyrator. A capacitor becomes an inductor and an inductor behaves like a capacitor when connected to the gyrator. Input impedance of the gyrator becomes infinite when its output is shorted, and becomes zero when the output is open.

26. Wide Range Frequency Deviation with a Three Stage RC Oscillator.

P. KUNDU, Kharagpur.

An asymmetrical three phase oscillator has been developed in which an amplifier stage has been coupled back to its input through two similar cathode follower stages, all of them having complex loads consisting of resistance and capacitance. Like a conventional three phase oscillator, only three stages are used here, each of which produces a phase shift; but unlike it, only one stage is used as an amplifier to produce the loop gain required by the system to oscillate. As in all multiphase oscillators, this oscillator has also possibility of maintaining oscillations at more than one frequency. When oscillations at the lower frequency mode is not wanted, it may be suppressed easily by properly proportioning the values of the interstage coupling network. The performance of this oscillator has been found to be more uniform and the adjustment less critical for optimum operating condition unlike the other types of RC oscillator.

A wide frequency deviation over a frequency ratio of 2:1 has been obtained by varying the grid bias of the cathode follower stages. The variation of frequency has been found to be practically linear over a considerable range without having any appreciable change in amplitude. The performance of this Oscillator as a frequency modulated system as regards linearity, freedom from amplitude modulation and the range of frequency deviation has been seen to be quite uniform over a frequency-spectrum of few Kc/s to few Mc/s.

27. A New Alternating Voltage Stabiliser.

J. K. CHOUDHURY and S. C. DAS GUPTA, Calcutta.

The paper describes the construction and design of an electronic stabiliser which can provide a voltage supply unaffected by fluctuations in the mains voltage for the testing and standardisation of a.c. instruments. The stabiliser constructed is of the differential type in which the unbalanced voltage of a four-arm lamp bridge is injected in the mains supply in proper magnitude and phase to cancel the effect of voltage fluctuations in the latter. A novel feature of this new stabiliser is the fact that the harmonic content of the final stabilised voltage has been arranged to be practically eliminated totally by incorporating a special harmonic elimination equipment with it. A new method has also been devised for the elimination of the unwanted fundamental frequency quadrature voltage and the third harmonic components of the unbalanced lamp-bridge output.

28. A circuit for obtaining odd Scaling Ratios at High Counting Speeds.

R. PARSHAD and S. K. SINGH, New Delhi.

Diode-gating techniques developed in the Laboratory have been used for modifying binary scalers to yield odd scaling ratios at unreduced counting speeds. The obtaining of odd scaling ratios is more complex than the more usual case of even numbers (decades). This is so, because in the former case, the first binary stage which receives the input trigger, has, when an advance of count is given by internally generated triggers, to be prevented from being triggered by these input triggers. This difficulty is overcome by comprising the input trigger system (amplitude discriminator) in the diode-gating system and sending blocking triggers to the first stage when any of the following stages are triggered by the triggers from the gating system.

The scalers are stable in operation and uncritical in circuit adjustment.

29. An Improved Form of Binary Step-Ring Counter.

R. PARSHAD and S. K. SINGH, New Delhi.

Diode-gating methods have been used to improve the working of a binary step-ring counter. The counter is of wide use, but its conventional circuit is critical in circuit adjustment. In the older circuits, the input trigger is effective only at the lone (or 'odd') state of a binary stage of the ring. The stage is triggered into an 'even' state and in so doing, triggers the succeeding to the 'odd' state. In the present work, by use of diode-gating methods, the 'even' stage next to the 'odd' is first triggered into the 'odd' state. In so doing, the previous stage is automatically returned to the 'even' state through common cathode coupling resistors.

The method employed improves the working of the ring counter since due to the switching methods employed the input triggers are less likely to go astray and do undesirable triggering in the new circuit than what is possible in the older circuits.

The stability of operation of the circuit is reflected in the increased biasing ranges possible in the new circuit.

30. Determination of the Quiescent Operating Point of Vacuum-Tubes for Positive Grid-Cathode Voltages.

R. PARSHAD, New Delhi.

Mathematical methods have been developed for determining the plate-currents of triodes for positive grid-cathode voltages for the general case of use of plate and cathode load resistors and a known grid to ground voltage. A load line has first to be drawn on the plate current-plate voltage characteristics. The slope of this load-line and the intercepts it makes on the voltage and current axes are different from the usual expressions for the case of no grid-current flow. Values of plate current and the associated grid-cathode voltage for any arbitrary point on this load-line are substituted in a mathematical expression for determining the actual plate-current flowing in the tube.

The work has application for quantitatively analysing the operation of multi-vibrators almost all kinds of which draw grid-current.

31. Determination of Quiescent Operating Point of a Differential Amplifier.

R. PARSHAD, New Delhi.

Methods have been developed here for the correct determination of plate-currents of triodes and pentodes in the general case of use of plate and cathode load resistors and arbitrary grid to ground voltages. These methods have been extended to the case of a differential amplifier, having a load resistor between the plates of the two tubes of the amplifier. The mathematical expressions arrived at for determining the tube-currents covers the general case of the tubes as well as their circuit parameters being different from each other.

IRRIGATION, FLOOD-CONTROL AND RIVER CONSERVANCY

32. Irrigation under First and Second Five Year Plans.

J. N. BASU, Jadavpur.

Irrigation, which means an artificial application of water to crops, is an art employed in India through ages prior to the commencement of the Christian era. Even the canal irrigation is traced to date back to the second century. Irrigation is necessitated due to the outstanding feature of rain-fall in India, as manifested by its unequal distribution during the year as well as from place to place and its variation from year to year in respect of quantity, incidence and duration.

The Storage project for irrigation is more costly due to construction of Dams, which may offset the high cost if combined with the uses of hydro-electric development and protection against flood damage.

It is estimated that the annual flow of water in rivers under Indian Union is equivalent to 1356 million acre-feet of which only 76 million acre-feet i.e. 5.6% are

used for irrigation and the rest flow waste to the Sea. It is considered to be possible to put to beneficial use about 450 millions acre-feet i.e. 33%.

Apart from rivers the underground waters constitute an essential source of water supply for domestic and agricultural purposes. Utilisation of sub-soil water is to be integrated with the exploitation of river waters. Substantial water supplies are available from the underground for irrigation, industrial and municipal uses. Water from wells is used for irrigation and domestic purpose from times immemorial. Ground water is generally available in all parts of the country and it was used for large scale irrigation in Uttar Pradesh, Bihar, Punjab, Rajasthan and Gujrat by means of power driven tube-wells.

The provision of irrigation facilities greatly affects the yield per acre. The increase in the yield in some areas comes up to 50% and in areas of low and uncertain rain-fall, the increase may be 2 to 3 times the yield from unirrigated lands.

During the last 45 years from 1901 to 1945, the irrigated area in British India increased from 30 million acres to 58 million acres i.e. 28 million acres in 45 years. The increase in agricultural products, on account of the enhanced irrigation facilities, was however more than counter-balanced by the increase in population. Moreover the partition of the country made the food position worse in the Indian Union.

So to meet with this piquant situation specially with respect to food, the planning commission recommended to double the area under irrigation, namely to provide irrigation facilities to additional 40 to 50 million acres, in 15 to 20 years. It was suggested in the First Five Year Plan to provide irrigation over 9 million acres. But very fortunately the irrigation facilities actually increased by 20 million acres during the First Five Year Plan. In the Plan-frame of the Second Five Year Plan, we found that the suggestion is made to increase the irrigation-area by another 30 million acres. So we can expect 100 million acres will be under irrigation at the end of Second Five Year Plan. This is just the double of what existed in 1950-51. Hence the Planning Commission can be congratulated to be able to double the irrigation facilities in India in 10 years, though originally it was of opinion that 15 to 20 years may be needed for the purpose.

The total expenditure suggested to be incurred for irrigation during the First Five Year Plan was 420.31 crores ; 270.21 crores under different states and a part of 287.1 crores in the Multi-purpose Schemes under the Central Government viz. 150.1 crores.

The maximum expenditure on irrigation in the First Five Year Plan in any State is 49.68 crores in Madras; next is 49.44 crores in Uttar Pradesh; 34.26 crores in Hyderabad; 27.09 crores in Mysore; 25.65 crores in Bombay and 19.41 crores in West Bengal. In the Second Five Year Plan the investment on irrigation and agriculture is suggested to be 950 crores, 750 crores in Public Sector and Rs. 200 crores in Private Sector.

Though the Second Five Year Plan is commonly termed to be mainly in favour of industries, still from the above it is clear, that the tempo of progress in irrigation-development will not only be continued but will be increased in intensity in the Second Five Year Plan, compared to the First Five Year Plan. It is gratifying to note that the advancement in agricultural aspects of the country is not lost sight of in the Second Five Year Plan period.

33. A New Relationship between the Discharge and the Length of a Channel from the Tail.

A. P. BHATTACHARYA, Roorkee.

A new relationship has been attempted between the discharge and the length of any channel from the tail. Its main utility lies in examining the working of

existing channels and also designing of new channels with the aid of some constants which may be known from some channels in the vicinity. It is particularly useful for detecting any discontinuities in the channel which enables us to know the state of affairs at any point.

34. Model Studies on Radial Wells.

K. P. SHUKLA, Roorkee.

The radial well depends on the principle of a lower head and proportionately greater yield. It consists of a central vertical concrete pipe with number of slotted pipes radiating horizontally into the water bearing strata. These slotted pipes function essentially as collection pipes, which collect water into the central pipe from where it is pumped up. Experiments were carried out to find out the efficiency, optimum length of radials, and their diameter, the position of these radials in the vertical plane that could yield maximum discharge. These experiments yielded following results :

1. The radials collect fine sand and develop a sort of shrouding of gravel and coarse sand, thereby increasing the area of infiltration.

2. When the pump is in action, besides, certain depression in the central pipe conical channels with gradually sloping and increasing depressions are formed along the radials. So, that instead of creating all the requisite heads in central pipe the heads are distributed all over the area of infiltration.

3. Putting the radials in staggered planes increases the yield with the same depression heads.

4. Increasing the length of radials beyond certain optimum does not proportionally increase the efficiency, similarly increasing the number of radials on the circumference of the pipe does not proportionately increase the discharge. Optimum results are obtained by putting radials at 60 degrees at one plane.

35. In-Filtration of Water from Canal into the Power House Pit.

K. P. SHUKLA and R. P. SRIVASTAVA, Roorkee.

In order to lay the foundations of Pathri Power House at mile 7 of Ganga Canal excavations were carried out upto to a depth of 19 ft. below the spring level. This was achieved by installing system of tube wells. In deciding the distribution of these wells seepage of water from the side of existing Canal was considered as it continually replenished the under-ground. To estimate losses from Canal and its contribution to ground water systematic observations, temperature of Canal Water, Sub-soil water and that of water pumped, were made and the results analysed. The analysis revealed that there is definite sign of seepage from Canal side, that the method is a reliable one and can be applied to determination of seepage losses from surface streams as influenced by well pumping situated in the vicinity.

36. Rainfall runoff Studies in Uttar Pradesh.

A. P. BHATTACHARYA, Roorkee.

In this paper, an attempt has been made to set forth the various rainfall runoff investigations carried out in the state of Uttar Pradesh and discuss the findings thereon. An analysis of the time series of rainfall figures for the last fifty years failed to detect any well defined cycle for more than twenty-five dis-

tracts. U.P. catchments were broadly divided into two classifications, namely
 (a) Bundelkhand catchments, lying in drier and hotter regions of southern U.P.,
 (b) Himalayan catchments.

Linear relationships were worked out between rainfall and runoff for three types of Bundelkhand catchments, namely, (i) steep bare catchments with hills, (ii) hilly catchments covered with forests, (iii) plain catchments. For Himalayan catchments, no relationship could be detected. Inglis formula between maximum flood discharge and catchment area was next tested for U.P. catchments, (a) from 0 to 100 sq. miles, (b) from 100 to 1,000 sq. miles, (c) from 1,000 to 10,000 sq. miles. This formula gave higher discharges for lower sized catchments up to 100 sq. miles, whereas for those above 100 sq. miles lower figures were obtained from the formula than recorded discharges.

Khoṣla temperature runoff formula was also tested for Dhukwan catchment in southern U.P., but the fit was poor. To conclude, no satisfactory rainfall runoff relationship has been deduced for U.P. catchments. Paucity of stream gauging stations, rainfall and temperature recording stations has been felt to be a major handicap in hydrological investigations.

37. Evaporation Losses from Water Surfaces.

P. P. SRIVASTAVA, Roorkee.

Correct estimation of evaporation losses from water surfaces is important in river valley projects. Uptil now this estimation is only a guess work from experience but the experimental methods to determine them are equally unstandard. Several methods of observations are available. A correlation between them sometimes exists and at others it does not. Object of the experiments reported here is to find a correlation between different standard methods and to attempt a practical applicability of the results obtained.

A, U.S. weather Bureau pan, colorado sunken pan, U.S. Geological survey floating pan and a large ground pan have been studied. The coefficients with respect to 20 feet ground pan have been calculated. Besides, the effect of such factors as humidity, temperature, rainfall and wind velocity have been studied.

38. Relaxation Methods and Problem of Seepage through Earth Dams.

K. P. SHUKLA and D. N. BHARAGAVA, Roorkee.

Design of earth dams require a complete knowledge of flow conditions in the dam and foundations. These flow patterns, technically called flow nets, are either obtained by model experiments or by mathematical analysis. Both these methods often become very difficult and tedious in cases of complicated boundaries and where number of zones of different permeabilities are involved. In such cases methods of successive approximations yielding results to desired degree of accuracy are resorted to. These methods give quick and reliable results. A method depending upon Southwell's Method of Relaxation has been developed and successfully applied to drawing of flownets for earth dams of homogeneous as well as stratified sections.

1. A Dam Section with Homogeneous Foundation :

In these cases the flow is governed by $\Delta^2 p = 0$ (1)
 Its solution by relaxation method depends on the finite difference equation

$$p_1 + p_2 + p_3 + p_4 - 4p_0 = 0 \quad (2)$$

as applied to a square net. The bund section with assumed boundaries are divided

into a square network and the phreatic line is at first arbitrarily fixed and a convenient square net is set. To every node on upstream side pressure values are given in terms of head of water while for other points they are assumed. The finite difference equation in general is not satisfied at all the points on the assumed phreatic line. At their vertical assumed boundary the stream lines are all vertical giving $dp/dx=0$ and at the horizontal boundary $dp/dx=-1$ while along the phreatic line $dI/dn=0$ (3). These boundary conditions yield residuals at the boundaries. The relaxation patterns, on account of which relaxation is to be carried out, is next determined by determining the residual equations at the surrounding nodes. The final values of pressure are thus determined by relaxing the residuals first at a coarser net and then at finer nets and the phreatic line tested by the conditions (3). These trials are carried out till correct phreatic line is found out. Repeating the above analysis of relaxation for whole section, pressures are determined at all points. The flownet is then drawn for whole of the dam and the foundations by reducing these pressures to potentials.

2. *A Dam Section with Stratified Foundations*: After fixing the boundaries of the pervious strata as before the whole section is divided into a square net of suitable size, and approximate values of pressures are given at vertical nodes. At all points within a region of a certain permeability the finite difference equation is the same as given by (2). But for points on the common line of two interfaces, the finite difference equation is different and is obtained by the fact that the pressure should be continuous or single valued and the vertical velocity of a particle on the interface as considered from one medium is the same as considered from other medium, i.e.

$$k_1(dp/dx+1)_1 = k_2(dp/dx+1)_2$$

From these considerations the residual equations for the points on the interface is deduced as :

$$R_0 = \frac{2 k_1 p_1}{k_1 + k_2} + \frac{2 k_2 p_2}{k_1 + k_2} + p_2 + p_4 - 4p_0 + 2h \frac{(k_1 - k_2)}{k_1 + k_2}$$

and for points on the interface where one mesh line is cut short, the residual equation is deduced as :

$$R_0 = \frac{2 k_1 p_1}{\xi(k_1 \xi + k_2)} + \frac{2 k_2 p_2}{k_1 \xi + k_2} + p_2 + p_4 + \frac{2h(k_1 - k_2)}{k_1 \xi + k_2} - \frac{2p_0}{k_1 \xi + k_2} \left[\frac{k_1(\xi^2 - 1)}{\xi} + 2k_2 \right]$$

and for points on the interface where two mesh lines are cut short, the residual equation is deduced as :

$$R_0 = \frac{p_1 k_1 (1 + \eta)}{\xi(k_1 \xi + k_2)} + \frac{p_2 k_2 (1 + \eta)}{k_1 \xi + k_2} + p_2 + \frac{p_4}{\eta} + \frac{h(1 + \eta)(k_1 - k_2)}{k_1 \xi + k_2} - \frac{p_0 h(1 + \eta)}{(k_1 \xi + k_2)} \left[\frac{k_1}{\xi h} + k_1 \xi / \eta h + \left(2 + \frac{2}{\eta} \right) k_2 / 2h \right]$$

From these equations the residuals are calculated and they are then relaxed with the help of relaxation patterns. These patterns are also deduced as before by finding out the change in residuals of the surrounding nodes due to a change in that central node.

The final pressure distribution is thus determined first at a coarser net and then at finer nets and the phreatic line is tested as before.

The flownet is drawn after deducing potentials from this pressure distribution.

39. Uplift Pressures below a Masonry Structures by Relaxation Method.

K. P. SHUKLA and D. N. BHARGAVA, Roorkee.

Determination of uplift pressures below the floor of masonry structures have got direct bearing on their design. These pressures are computed by solving the Laplace's equation

$$\Delta^2p=0 \dots\dots\dots (1)$$

with respect to known boundary conditions. In simple boundaries the solution is easy, but, the floors of masonry structures are very often complicated and rigorous mathematical solution in such cases becomes very difficult and tedious. Model experimentation also has got its own defects. Methods of successive approximations have the advantage of quickness and universal applicability.

In this paper Southwell's method of relaxation has been applied in determining the uplift pressures below the floor of Jagbura Syphon and the values obtained have been compared by mathematical analysis.

The floor of the syphon is a depressed floor with aprons on upstream and downstream side. Along the floor the approximate values of the pressures are determined by the usual inverse cosine formula :

$$p=\frac{H}{\lambda}\cos^{-1}(2x/b-1) \dots\dots\dots (2)$$

At fairly large distance from U.S. and D.S. ends of the floor boundaries are assumed where stream lines are vertical. Similarly another boundary is assumed where they are supposed to be horizontal. The whole region is then divided into a net work and approximate values for pressure are given. The finite difference equation to the governing Laplace's equation is

$$p_1+p_2+p_3+p_4-4p_0=0 \dots\dots\dots (3)$$

By the help of (3) and the boundary condition of $dp/dx=0$ at vertical boundaries, $dp/dy=-1$ for horizontal boundaries, the residuals are calculated. The residual equation for vertical boundary is :

$$R_0=2 p_1+p_2+p_4-4 p_0=0 \dots\dots\dots (4)$$

and for horizontal boundary :

$$R_0=2 p_2+p_1+p_3-4 p_0, 2h=0 \dots\dots\dots (5)$$

These are relaxed by means of relaxation patterns which are determined by finding out and change in residuals at the surrounding nodes due to a change in pressure at that node.

The final values are determined at the finer net and the potentials are deduced by the equation

$$p=\phi \pm h$$

from which flownet can be drawn and the pressures obtained at critical points.

In order to find exact mathematical solution the depressed floor was transformed conformally by the help of the equation

$$Z=A\int\sqrt{\frac{\xi^2-k^2}{\xi^2-1}}d\xi+B \dots\dots\dots (6)$$

and the pressure at various points were calculated from the known solutions of simple floor. It was seen that the approximate solutions by relaxation method compare very well with the exact solutions. The values obtained by former method were found satisfactory for design purposes.

40. Application of Three Dimensional Electrical Analogy Method for the Design of Structures on Permeable Foundations.

R. P. SRIVASTAVA, Roorkee.

Floor of weirs on permeable foundations has to be designed such that it is safe against uplift pressures. These pressures as functions of total potentials are determined, analytically as solutions of Laplace's equation

$$\Delta^2 h = 0$$

with respect to known boundaries. Often, rather generally the boundaries of the structures are so complicated that mathematical solution in many cases does not exist. Experimental methods based on electrical analogy models and laws of hydraulic similitude give easy solutions. Investigations were carried out to determine uplift below the floor of a syphon by two dimensional electrical analogy models. It shows that designs based on two dimensional analogy are incorrect and are sometimes erroneous. The problem of weir design is essentially a three dimensional one.

In this paper three dimensional electrical methods were evolved and the problem of syphon design studied with the help of the results obtained. The designs worked out on the basis of these experiments were much more sound than here-to-fore attempted according to two dimension rules. The method is under evolution and results are promising.

ENGINEERING RESEARCH

41. Irreversible Thermodynamics of the Thermal Characteristics of Porous Insulators.

R. G. MOKADAM, Kharagpur.

Heat transfer through porous insulators is commonly considered as a problem in heat conduction. This problem is analysed with the aid of irreversible thermodynamics.

For thermodynamic study, it is assumed that the solid and the gaseous phases in a porous insulator are dispersed. By suitably defining the bulk pressures and densities of the phases, equations of the continuity of mass, momentum, energy and entropy are developed.

The entropy equation contains terms which indicate entropy generation due to two irreversible processes: heat flow in the presence of temperature gradient, and gas flow in the presence of frictional force. These flows are assumed to be linearly dependent upon the temperature gradient and the frictional force. This assumption includes two cross phenomena: convective heat transfer, and free convection. They are interdependent.

Usually the frictional force is equal to the gaseous phase pressure gradient. When this pressure gradient is zero, the heat flow depends only upon the thermal gradient. By entrapping the gas in the porous medium, the gas flow is stopped. This gives rise to a pressure gradient which sets up a convective heat flow opposing that due to thermal gradient. Consequently the thermal conductivity of the porous insulator decreases.

42. Linear Voltage Sweeps Employing Sinusoidal Waves.

R. R. DUTTA GUPTA, Kharagpur.

So long linear voltage sweeps for cathode Ray Oscilloscopes have been generated by charging a condenser through a resistance. The small linear portion

of the exponential wave obtained during the charging process is then magnified and utilised as a linear voltage sweep. In this paper is described a method of utilising steep portions of sinusoidal waves as linear voltage sweeps. This leads to an improvement in linearity because of the fact that steep portions of the sine waves are extremely linear.

On expanding both the exponential and sinusoidal functions for t (time) small we find that in the former case the function departs from linearity as the square of time whereas in the latter deviation from linearity varies as the cube of time. So that for small t the latter gives better linearity.

The method described in this paper is simple and easy to design. It is hoped that the principle introduced here will open up a new line in the generation of extremely linear voltage sweeps. This principle is also expected to simplify the design of equipments for fast sweeps.

43. Measurement of Initial Permeability of Soft Iron at Centimetric Wavelength.

G. S. SANYAL, Kharagpur.

The r.f. permeability of ferromagnetic materials is complex and can be expressed in terms of two apparent permeabilities μ_R and μ_L . In order to study the dispersion of ferromagnetic permeability measurement of both μ_L and μ_R in the centimetric wavelength range is required. This paper describes a method of measurement of μ_L of soft iron in this wavelength range (free-space wavelength 3.19 cms). The method of finding the value of μ_R in the same wavelength range by using a cavity-resonator has already been described (Sanyal and Chatterjee, 1953). The present method of measurement of μ_L is based on the fact that the resonant frequency of a brass cylindrical cavity resonator changes slightly when one of its end walls is substituted by a similar end wall of soft iron. The resonant frequency of this test cavity is compared with that of another similar cylindrical cavity resonator, once when one of its (test cavity) end walls is made of brass and again when it is of soft iron. The change in the resonant frequency of the test cavity due to the substitution of one of its end walls by soft iron is found by utilising cavity comparator technique. The frequency shift due to the change of the geometry of the cavity end wall has been made small by using accurately machined surfaces. Expressions have been derived relating the permeability μ_L with the cavity parameters and the shift in the resonant frequency. The experimentally obtained value of μ_L at a wavelength of 3.2 cms was 2.85. This agrees closely with the results obtained by other workers.

44. Flow Properties of Some Indian Building Paints.

G. W. KAPSE and N. K. PATWARDHAN, Roorkee.

Consistency of paints and its measurement is very important as it directly or indirectly affects their performance. The specifications issued by the Indian Standards Institution do not specify any method for the measurement of consistency of paints. It was, therefore, decided to investigate the flow properties of paints, manufactured to I.S. Specifications which are used for the protection and decoration of buildings. Ready mixed paints in 15 different shades as obtained from a leading manufacturing firm were studied. The samples from other leading firms are also being investigated.

The present paper discusses the results of consistency and other properties of the 15 paints supplied by one firm; these results are given in a tabular form.

Three instruments viz. the Flow Cup, Gardner Mobilometer and the MacMichael Viscosimeter were used. All the measurements were carried out at $25^{\circ}\text{C} \pm .5^{\circ}\text{C}$.

On the basis of the results of the present investigation it is seen that in order to possess good brushing and levelling qualities the flow characteristics of the samples may fall within the following limits : (i) plastic viscosity 2.42 to 3.86 poises ; (ii) consistency between 90 to 240 seconds and between 30 to 70 seconds, as measured by the Flow Cup and the Gardner Mobilometer, respectively ; (iii) the yield values, 340 to 640 dynes/sq. cm.

On the basis of the results on the consistency measurements the use of the Gardner Mobilometer is indicated for control purposes as it affords a better control of temperature.

45. Pressure Drop in the Flow of Suspensions.

B. GHOSH, Jadavpur.

Many industrial processes require transportation of powdered solids in the form of a suspension in air or in a liquid medium. So it is necessary to obtain information on the pressure differential which will produce a required flow of a given suspension through a conduit. Experimental results of various workers have been reviewed. The latest workers have correlated their results by considering relative pressure drop (i.e., the ratio of pressure drop due to the flow of suspension to that due to the flow of the dispersing medium alone at the same flow rate) as a function of the ratio of tube diameter to particle diameter, the ratio of the density of the solid to that of the medium, dust loading (in weight ratio), Reynolds number and the drag coefficient. However, the analysis of data available in the literature by the present author showed that for flow of solids suspended in air the effects of the ratio of tube diameter to particle diameter, the Reynolds number and the drag coefficient were not significant. In the flow of a liquid slurry, however, the effect of Reynolds number was considerable though the effects of the ratio of tube diameter to particle diameter and the drag coefficient were not very significant. The following empirical equations have been proposed by the author for correlating the available data :

(a) Horizontal flow of suspensions in air :

$$d-1 = 3.8 \left(\frac{W}{\rho} \right) r^{0.648}$$

(b) Vertical flow of suspensions in air :

$$d-1 = 6.1 \left(\frac{W}{\rho} \right) r^{0.701}$$

(c) Flow of liquid slurries :

$$d-1 = A \left(\frac{W}{\rho} \right) r^{-1.0} \quad (A \text{ is on the order of } 6000)$$

where d is relative pressure drop, W is density of the medium, ρ is the density of the particle, r is the weight of solid particles in lb. per pound of the medium, and Re is the Reynolds number.

The above proposed equations are valid within the range of investigations reported in the literature. They should be used with due caution while extrapolating outside the range of investigation.

46. Laboratory Experiments on Resistance Heating of Massecuities.

K. S. G. DOSS and VISHNU, Kanpur.

For obtaining maximum exhaustion of molasses, it is often an advantage to cool the massecuite to a very low temperature. Such cooled massecuities would attain very high viscosity so much so that the curing of the massecuits in the centrifugals becomes difficult and ineffective. To obviate this difficulty it is necessary to reheat the massecuities.

Usual methods of reheating of massecuite are time consuming and involve loss of sugar due to dissolution of sugar crystals.

The heat transfer presents a serious problem, since the film coefficient of the heat transfer on the massecuite side is exceedingly low, owing to high viscosity of massecuities. Whenever heat transfer becomes a serious problem, one has to consider the possibility of carrying out the heating preferably by an agency not depending on heat transfer. Among such agencies resistance heating is one. Laboratory experiments on the resistance heated are therefore tried. A heating unit made up of rectangular wooden box with a grid of electrodes (iron rods) has been designed. The electrodes are arranged in a staggered manner so as to make the treatment uniform throughout the mass. The massecuite is allowed to flow from the top and constant discharge is maintained at the bottom. Encouraging results are obtained. When the massecuite is heated to raise the temperature through 15°C, the output from the heating unit is found to give an uniformly heated massecuite where temperature remains constant correct to $\pm 0.5^\circ\text{C}$.

47. Improving the Suitability of Saw-dust for Use in Mobile Bed Hydraulic Models.

S. C. BARAI, Poona.

Saw-dust may be improved to be the most satisfactory bed material for moving bed hydraulic models if its undesirable properties viz., it does not sink easily and decays rapidly and forms flocks on the model bed, can be prevented. Experiments carried on to develop some chemical treatment of saw-dust for making it more suitable for hydraulic experimental models showed that lime was the best of the chemicals studied for the purpose. Treating the saw-dust with lime made it more hard to feel and helped it sink easily. As little as 0.5 per cent by volume of quick lime was enough for making the saw-dust sink and treating the saw-dust with only lime water also gave quite good results. It was also observed that copper sulphate was the best for prevention of flock formation in saw-dust. Saw-dust treated with lime, washed, then treated with one per cent copper sulphate solution and then washed again, sank easily and was protected from flock formation for about two months.

48. Dynamical Stability of Ship.

SAILESH CH. CHAKRABORTY, Calcutta.

The interaction of the forces buoyancy (B) and centre of gravity (G) constitutes the stability of the Ship. When a ship heels the volume of water displaced does not change but the shape of the transverse section of this Vol. does change.

The work done in heeling a vessel is the Dynamical Stability.

$$= W \times \overline{GL}$$

$$= W(\overline{GM} - \overline{GM} \cos \theta)$$

$$= W \cdot \overline{GM}(1 - \cos \theta).$$

In a rectangular vessel of 1 foot length; b feet breadth and heeled through the small angle θ .

$$\text{Weight equivalent of Wedge} = \rho \left(\frac{b}{2} \times \frac{b}{2} \times \theta \right) \times 1 \times w.$$

$$\text{where } w = \text{density of water} \quad = \frac{b^2 l w \theta}{8}$$

$$gg_1 = \left(\frac{2}{3} \text{ of } \frac{b}{2} \right) \times 2 = \frac{2b}{3}$$

$$\therefore \text{Moment due to transfer} = \frac{b^2 l w \theta}{8} \times \frac{2b}{3} = \frac{b^3 l w \theta}{12}$$

Moment is also $= W \times \overline{BB_1}$, where $W = \text{wt. of the vessel}$.
or $W = v \times w$ when $v = \text{Vol. of displacement}$.

$$\overline{BB_1} = \overline{BM} \theta \text{ (for Small Angle } \theta \text{)}$$

$$\text{or } \overline{BM} \theta \times V \times w \times W = \frac{b^3 l w \theta}{12}$$

$$\text{or } \overline{BM} = \frac{b^3 l}{12V} = \frac{I'}{V}; \text{ I the moment of inertia of the}$$

$$\text{Waterplane about longitudinal centre line of Vessel} = \frac{b^3 l}{12}$$

$$= \frac{\text{Moment of inertia of Water plane area}}{\text{Volume of Water displaced.}}$$

and is true for any vessel.

49. Development of a Wax Blend for Construction of Ship Models for Use in the Ship Testing Tank.

B. B. ROY and TARA SINGH SIDHU, Poona.

At the Central Water and Power Research Station, Poona, a ship testing tank has recently been constructed to carry out various tests with ship models. Paraffin wax, used in cold countries for construction of these models, was found unsatisfactory for a tropical country like India. A wax blend consisting of a 1 : 1 mixture of montan wax and paraffin wax has, however, been found suitable for the purpose. Its melting point is sufficiently high. It is hard and strong, yet is soft enough to be worked easily with ordinary wood working tools and takes a smooth surface. It is homogeneous and can be easily melted and poured into the mould. The coefficient of expansion is very low so that change in shape of the ship model with variation in temperature will be inappreciable. Bending test shows a high softening point so that the wax will be able to stand the hottest summer temperature of Poona.

MISCELLANEOUS

50. Structural Variations in Metals Subjected to Explosive Stresses.

M. W. CHIPLONKAR and B. S. SATYANARAYANA.

Investigations were carried out with a view to determine in a general way the nature of the effects of explosive stresses on the structure and properties of metals. Previous workers in this field have reported on the nature of fractures,

dimensional shrinkages, shape deformities and other similar effects caused by explosions in the cavities of massive objects. Of special interest is the recent observation made by John Pearson & John S. Rinehart of the existence of the hardness plateaus lying transverse to the direction of propagation of the shock waves.

In our investigations several cylinders of different diameters ranging from 1.5" to 3.5" were cut out of rolled rods of brass and mild steel and small holes were bored to the same depth axially in which the plastic explosive materials were packed and exploded in safety ditches, dug in the ground. Two plates of mild steel, 4" x 4" x $\frac{1}{2}$ " mounted parallel to one another about 1" apart were also exploded similarly. Measurements of hardness and grain size were made at numerous points on each of the several cross sections taken both along and transverse to the direction of propagation of the shock waves. The results are presented in the form of typical photomicrographs and average curves showing the variation in each of these quantities from point to point caused by the explosive stresses.

It is found that on the whole the change in hardness of the material gradually decreases as we proceed along the direction of propagation of the shock waves. Maximum increase in hardness is observed at the cross section at which a maximum reduction in radial thickness has occurred. In some cases an edge effect indicating a slight increase in hardness at the outer surface is also observed. An increase in hardness seems to be associated with an increase in the number of grains per unit area. Further work is still in progress.

51. Ball Mill Performance with Different Crushing Media.

B. C. DATTA and S. K. NANDI, Kharagpur.

A steel ball mill, 8" dia. x $8\frac{1}{4}$ " length and operated at 44 r.p.m. was charged with different crushing media :—(1) 1" dia. steel balls—100 Nos. (2) 1" dia. porcelain balls (3) $1\frac{1}{2}$ " dia. steel balls (4) steel rods 1" dia. x 1" length (5) steel rods 1" x $3\frac{3}{4}$ " (6) steel rods 1" x $7\frac{3}{4}$ " (7) steel rods 3" x $7\frac{1}{2}$ " (8) steel bars 1" x 1" x $7\frac{1}{2}$ ". In each case the total weight of the grinding media was equal to that of 100 steel balls, which occupied 24.4% of the mill volume. The mill was operated for

30 minutes with 250 and 500 gms. of coal, $\frac{1''}{8}$ to $\frac{3''}{16}$ size and the product was sieved

in the range 10-300 mesh. Mill performance was estimated from the new surface created, which was obtained from the area under the curve-cumulative per cent under size versus reciprocal of size.

With 250 gms. feed, the areas for the 8 different crushing media in the order given above were 49.5, 49.4, 50.7, 58.7, 59.8, 50.6, 32.6 and 40 cm²; while 500 gms feed the areas were 43.8, 41.8, 41.7, 45.0, 42.0, 37.8, 28.4 and 39.7 cm². Results show that maximum efficiency is obtained by 1" x 1" rods followed by 1" balls.

52. On the Hydromechanics of Breaking Waves—Energy Absorption in Maritime Structures.

DR. S. K. ROY, Poona.

The wave forms associated with the breaking wave, the absorption, transmission and reflection of wave energy and the impact pressure transients have been studied in some aspects in laboratory tests and also to some extent in prototype by various agencies connected with maritime structures researches. Systematising

the physical laws involved has been difficult due to the finite amplitudes involved and due to a lack of exact knowledge of the energy exchanges involved in breaking waves. A good example of the linearised treatment of the deep water waves for fairly flat slopes is contained in P. Biesel's contribution in gravity waves. It is difficult to take detailed account of the wave breaking and energy absorption in such cases, without a knowledge of the effect of finite amplitudes. In the present paper, use is made of the linearised solution for shallow water waves for dealing with a variety of cases in closed form. Following the usual field equation of the problem, the characteristic features of an advancing progressive wave on sloping beach and the breaking are reproduced. The propagation of wave energy and the energy of a breaking wave are analysed to obtain the absorption functions for different parameters of the wave. Transition from deep water to shallow water is examined, and a deep water parameter is used for obtaining the different values of energy absorption function. The limiting criteria for large wave-lengths and steep slopes are also deduced. A comparison with J. Healy's data, shows good agreement in the order of absorption values and in the general trend of its rise with increasing flatness of the beach. The absorption criteria are important for sea walls and breakwaters as well as harbours. Further work on the second order effects and in observations of harmonics in the reflected waves would add to the rational treatment of the physical aspects of the breaking wave and its importance in maritime structures.

METALLURGY

53. On Dephosphorisation of Cast iron in Hydrogen.

B. CHATTERJEE and K. R. SANGAMESWARAM, Sibpur.

Studies have been made of the progressive removal of phosphorus from powdered samples of a specimen of cast iron (P, 1.30%) on heating in a current of hydrogen containing 1.2 per cent. by volume of moisture. The phosphorus content has been found to decrease to 0.95% in 8 hours and to 0.90% in 25 hours. Very little dephosphorisation has been found to take place after 25 hours. These results confirm our previous observation (Proc. Indian Sci. Cong. Assn., III, 426, 1955), viz. that the phosphorus contents of two samples of cast iron containing 0.76% and 0.50% P, were not reduced on treatment with moist hydrogen at 1000°C.

54. Studies on the Nature and Distribution of Mineral Matter in Indian Coals.

PARIMAL SEN, G. B. MITRA and A. N. ROY, Kharagpur.

The distribution of mineral matter in different size fractions obtained on crushing and screening of common Indian coals was reported in an earlier publication. The general trend was a decrease in the ash content from coarser to finer sizes. In the present investigation the different size fractions of a sample of Digwadih Grade III B Coal have been examined to study (i) the distribution of petrographic constituents, (ii) the distribution of mineral matter by chemical analysis of the ash and X-ray diffraction photography of the coal powder.

It has been found that the vitrain and clarain content in the coal is low, about 4 per cent, and these ingredients concentrate more in the finer sizes, the variation in distribution being 1.1 per cent in -10+25 mesh to 6.5 per cent in -150+200 mesh. Fusain follows a similar trend. Its distribution varies from 16.2 per cent in -5+10 mesh to 26.9 per cent in -52+150 mesh sizes. The durain content which is very high exceeds 70 per cent and concentrates more in the larger

size particles. The variation is from 82.5 per cent in $-5+10$ mesh to 68.8 per cent in $-150+200$ mesh. From the chemical analysis of ash it has been found that while the silica content is lower in finer sizes (49.2 per cent in $-52+150$ mesh) than in coarser sizes (54.7 per cent in $-5+10$ mesh) the oxide contents of iron, aluminium etc. are higher in the finer sizes.

By X-ray analysis, the presence of the minerals—muscovite, quartz, chlorapatite, grossular, garnet and pyrrhotite, have been detected.

55. Some Characteristics of Martensite Formation After Conditioning Treatment.

S. C. DAS GUPTA, Howrah.

Austenite-martensite transformation in steel is influenced by arresting the transformation and reheating above M_s temperature. Depending upon the temperature of reheating further transformation may be decreased or increased in amount. The latter process is termed conditioning. Some aspects of the conditioning phenomenon with respect to austenite-martensite transformation in a 15 pct. chromium 0.7 pct. carbon steel has been studied in this investigation. The degree of conditioning is measured by the amounts of martensite formed on subcooling specimens containing some initial martensite, subsequent to the reheating treatment in the range of 350 to 600°C. Increasing temperature of reheating progressively increases the degree of conditioning. Above the reheating temperature of 450°C an important change is observed in the mode of the nucleation of some of the martensite plates formed on recooling. The edges of the initial martensite plates appear to act as nucleation sites for further formation of martensite plates. On reheating above 500°C a substantial amount of further transformation is contributed by small-sized feathery martensite formed preferentially in the neighbourhood of original martensite plates. The above mentioned modes of formation of martensite are explained by assuming the possibility of depletion of carbon and chromium from the austenite in the immediate vicinity of the prior martensite plates.

56. Effect of Undissolved Carbide on the Stabilisation of the Austenite-Martensite Transformation.

S. C. DAS GUPTA, Howrah.

The amount of carbide remaining undissolved after austenitizing treatment has been found to play an extremely important role on the transformation of austenite to martensite in a 15 pct. chromium 0.7 pct. carbon steel. In this steel a critical amount of the undissolved carbide, produced by austenitizing at 1225°C for 2 hours, stabilises the austenite completely against transformation even upto liquid oxygen temperature, after quenching in brine at room temperature. However, the change in the amount of the undissolved carbide, brought about by austenitizing above or below 1225°C for the same length of time, failed to produce such stabilisation. The higher temperature of austenitizing possibly did not produce sufficient amount of carbide to cause the phenomenon, whereas the lower temperature retains appreciably large amount of carbide decreasing the alloy and carbon content of the parent austenite and thus making the transformation of austenite to martensite more potent. Carbide particles may provide sufficient number of regions of carbon concentration, so that carbon atoms may diffuse into the regions of martensite embryos. They may also lower the effective grain size of the material. Partial stabilisation effect was noticed in the case of the specimens austenitized at about 1235°C, quenched in brine at room temperature and cooled immediately to subzero temperatures. However, holding at room temperature before subcooling produced complete stabilisation for 1235°C austenitizing treatment also.

57. X-ray Diffraction Studies of "Vanadium-titanium Bearing Iron Ore" of India.

P. K. SEN, R. K. MITRA and G. P. CHATTERJEE, Shibpore.

The Vanadium-titanium bearing iron ore of India has great potentialities particularly because of its vanadium-content. The conventional method of treating the ore in an iron blast furnace is not possible because of its high titanium content. For the purpose of utilising this ore-mineral economically it is necessary to know the nature of the compounds occurring in the raw untreated ore and also the changes it undergoes during oxidation and reduction treatments. An attempt has been made in this paper to investigate by X-ray diffraction the constituents present in the raw ore, in the ore after roasting in air and after reduction by coal gas. It has been found that the raw ore contains Fe_2O_3 , Fe_3O_4 and FeO.TiO_2 and small amounts of TiO_2 . There are indications of the presence of $\text{FeO.V}_2\text{O}_3$ also. The roasted ore contains mostly Fe_2O_3 and small quantities of the other constituents. The reduced ore contains mostly Fe, small quantities of Fe_2O_3 , FeO.TiO_2 and TiO_2 . The sequence of the presence and absence of certain lines and the changes of the relative intensities have been discussed.

58. Thermodynamics and Kinetics of Anelastic Behaviour of Metals and Alloys.

DR. G. P. CHATTERJEE, Sibpore.

It is well known that metals and alloys are neither truly elastic nor truly plastic and work-harden on deformation. In an isothermal deformation of a work-hardening material whose state is defined by tensors of stresses and plastic strains it is assumed for mathematical simplicity that under a given mechanical state and an infinitesimal change of stress, the change of strain is uniquely determined. The stress-strain relation of a work-hardening material is, for simplicity again, assumed to be homogeneous and linear. In spite of the usual rigorous mathematical approach conditions of continuity, uniqueness, irreversibility and consistency often put serious restrictions and lead to oversimplifications of the result. A different approach has been attempted in this paper—first a thermodynamic treatment of the problem and then the kinetic approach to introduce the effects of rates of stress and strain. A formal thermodynamical approach yields the following relations :

$$d\sigma = G_t (d\varepsilon - \alpha dT) \quad (1)$$

$$\text{and} \quad dT = \frac{T ds}{C\sigma} - \frac{\beta}{G_s} d\sigma \quad (2)$$

where $d\sigma$, $d\varepsilon$, dT and ds stand respectively for changes in stress, strain, temperature and entropy/volume of the material, G_t and G_s are isothermal and adiabatic moduli of elasticity, $C\sigma$ is the specific heat at constant stress, α is the coefficient of thermal expansion and β is the adiabatic change of temperature per unit strain. The kinetic approach is introduced with the assumption that

$$\frac{d}{dt} \int \frac{T ds}{C\sigma} = -\frac{\Delta T}{t\sigma} \quad (3)$$

where $t\sigma$ is the time of thermal relaxation under constant stress. It has been shown that these three relations under different specified conditions help to explain the anelastic behaviour of metals and alloys.

59. Rate of Oxidation of Carbon Steels at Different Temperatures on Vacuum Diffusion of Nickel and Chromium.

S. S. PANI, K. C. SOM and G. P. CHATTERJEE, Sibpore.

It is well known that carbon steels have comparatively high rates of oxidation particularly at elevated temperatures. Several different oxide-layers are formed and the rate of oxidation is governed by the nature of the base metal, the nature of the film or films formed and the environment. Among other factors ionic and/or electronic conductivities of the films play an important role in controlling the rate of oxidation. A suitable complex film with low ionic and/or electronic conductivity may reduce the rate of oxidation. An attempt has been made in this paper to form a layer of Fe-Ni-Cr by high temperature diffusion of Ni and Cr under vacuum and subsequently study the rate of oxidation at different temperatures. It has been found that the rate of oxidation is cut down more effectively by prior short-time diffusion anneal under vacuum rather than longtime anneal. Apart from fundamental studies on diffusion, the potential usefulness of this process has been indicated.

60. Rate of Oxidation of Aluminium-Titanium Alloys at Different Temperatures.

K. R. SANGAMESWARAN, B. CHATTERJEE and G. P. CHATTERJEE, Sibpore.

The rate of oxidation of metals and alloys are governed by (i) the properties of film formed on the surface (ii) the diffusion of atoms or ions taking part in the formation of the film, (iii) the environment and (iv) the temperature. For a given temperature and environment, therefore, the rates of formation of film are governed essentially by the nature of film formed and the diffusion coefficients of the atoms or ions concerned. It is well-known that Ti increases the corrosion resistance of many alloys. An attempt has been made in this paper to describe quantitatively the behaviour of the oxidation of Aluminium-Titanium alloys containing 0.1 to 0.4 per cent. of Ti when heated in dry air at different temperatures. It has been found that (i) for samples containing 0.1 and 0.2% Ti, the loss of weight is a logarithmic function of time at 180°C and 360°C. (ii) for sample containing 0.4 per cent of Titanium, there is slight departure from the logarithmic law. The causes for both the above observations have been discussed.

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